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Steam Turbine Pumps for Water Works.

The steam turbine as a commercial motor is an accomplished fact. Of the three principal types on the market in this country the total aggregate sales, here and in Europe, now amount to about 1,500,000 horse-power. Its peculiar fitness for driving electric generators has created for it so large a demand in that field that comparatively little has been done in the way of developing it for use in connection with centrifugal or turbine pumps. This is true although one company has for several years past been building turbines of almost all sizes up to 300-h.p., directly connected to high-speed centrifugal pumps of its own manufacture.

At the meeting of the American Water Works Association held at West Baden, in May of this year, Mr. Charles A. Hague read a paper on the commercial pumping engine, in which he gave, among other valuable data, the results of a number of tests of reciprocating steam pumping engines. At the same meeting, Mr. Dabney H. Maury read a paper, illustrated with lantern slides, on steam turbines for water works, in the course of which, after illustrating the distinctive features of the different types of turbines built in this country, he presented tables and diagrams showing the sizes, speeds, costs, and duties of the three principal types of turbines, directly connected to centrifugal pumps for water works service. Data obtained from these two papers and from the discussions which followed them permit drawing some comparison of the economies of reciprocating pumping engines and steam turbine-driven pumps.

Mr. Hague stated that a reciprocating steam pumping engine of the best modern type and of a capacity of 10,000,000 gal. per 24 hours against 100 lb. pressure would cost, complete with foundations, ready for service, about $60,000; and that the best test record ever made, here or abroad, by a steam pumping engine showed a duty of 179,454,250 ft.-lb. per 1,000 lb. of steam.

According to Mr. Maury, a number of makers are already willing to guarantee 70 per cent. efficiency for their centrifugal or turbine pumps, and expect to get much better results. Claims of over 80 per cent. efficiency have already been made, and he could see no reason why, with further improvements and under favorable conditions, the efficiency of the modern turbine pump should not ultimately equal that of its prototype, the hydraulic turbine, which had frequently developed 85 per cent. Applying the pump efficiency of 80 per cent. to the diagrams presented by Mr. Maury, instead of the 70 per cent. on which those diagrams were based, the result, averaged from a large number of published tests of steam turbines of horse power equal to that of Mr. Hague's pumping engine, would be a duty of 125,000,000 ft.-lb. per 1,000 lb. dry steam. The cost of such a turbine unit complete on foundations, ready for service, would, according to Mr. Maury, be about $20,000.

The daily work done by each of these two units would be 19,250,000,000 ft.-lb. per 24 hours. Assuming an evaporation of 8 lb. of steam per pound of coal, the coal required per day for the reciprocating pump would be 14,154 lb., and for the steam turbine pump, 19,250 lb. If both units were to work at exactly full load for 24 hours for 365 days in the year, with coal at $3.00 per ton, the difference in annual coal bill in favor of the reciprocating engine would be $2,790. Capitalizing this amount at 4 per cent. for interest and 4 per cent. for depreciation we have $34,875. Adding this sum to the first cost of the steam turbine unit, we find that the cost of that unit would become $20,000 + $34,875 = $54,875, as against $60,000 for the reciprocating unit. This comparison shows that, other things being equal, the steam turbine unit would be the more profitable investment by about $5,000.

But no pumping engine is ever expected to run continuously at exactly full load, every day for twenty-five years. Almost every pumping station has pumps of a total capacity several times as great as the average daily consumption. This condition results partly from the great variation from time to time in the rate of pumping, and partly from the necessity of having some pumps in reserve while others are in service. Assuming that both units are to work half the time, the saving in annual coal bill in favor of the reciprocating unit would be only $1,395, which would capitalize at 8 per cent., $17,438. A comparison of the investments on this later and more rational basis shows a saving of $60,000—($20,000 + $17,438) = $22,562 in favor of the steam turbine unit.

Leaving out the items of first cost of machinery and foundations and of costs of fuel and depreciation, which have both already been considered, the steam turbine unit has the following advantages: Small floor space and head room, small expense for buildings, small expense for care and attendance, freedom from vibration, simplicity of packing, small number of bearings and moving parts, readiness with which repairs can be made and parts renewed, comparatively small size of all parts ensuring more perfect material, no oil in condensed steam, thus practically solving the serious problem of feed water.

The one disadvantage of the steam turbine pumping unit would seem to be the inability to vary its speed through any wide range. For direct pressure pumping this might prove an obstacle which could only be partially met by having a by-pass from discharge to suction, with a relief valve, so that when the pressure in the mains increased beyond a certain point, due to lack of draught, the pump would still continue working, but would be simply churning some of its water, with consequent loss of efficiency. Pumping into a reservoir, the turbine pump could, of course, always work at its full load and best efficiency. For fire service, where only occasional use is required, the low first cost of the turbine unit, combined with its many other advantages, would make it almost ideal.

The above comparison would seem to show that the steam turbine pump is destined to be, in many places, and in the near future, a competitor of the reciprocating steam pumping engine.

Effect of High Temperatures on the Physical Properties of Concrete.

The resisting and other physical properties of structural materials at high temperatures now play an important part in the general field of building construction. It is only within the past twenty-five years or about that period that the construction of large and high buildings has covered considerable areas in great cities. Conflagrations in cities are as old as cities themselves, but it is only within recent years that building construction has assumed such a character as to make the fire-resisting properties of materials of crucial importance in large structures.

What may be termed the general temperature of the active part of a conflagration is not extremely high, and if it can be shown that building materials of a certain class afford a satisfactory ultimate resistance at that temperature they may be considered safely fireproof. A building constructed of such materials would in all probability survive a great fire with little or no essential damage to its main carrying parts, and it certainly would form a most effective fire break. Practically all of the natural building stones have been tried and failed to sustain the trial, granite being an unqualified failure under such conditions. It is a little curious that artificially produced building materials of the nature of stone have proved to be far more fire resistant than the products of nature, brick and concrete thus far standing much in advance of natural stone in fire-resisting qualities.

The most of the information regarding the fire-resisting qualities of building materials has been secured in actual conflagrations. This is highly satisfactory from one point of view, but the method is costly and not under a degree of control that will yield quantitative results. There have been a few laboratory or small scale tests made with cast iron and wrought iron columns, giving approximate but valuable information, at least of the temperature at which those members may be expected sensibly to lose resisting capacity, but so little has been done in connection with stone, brick and concrete, that it may be considered practically nothing. Some interesting experiments with concrete cubes at high temperatures have been conducted in the U. S. Arsenal at Watertown, Mass., and reported in the "Tests of Metals," and a little similar work has been done elsewhere, like that described in The Engineering Record of July 22, 1905; but the total is of small amount and fragmentary in character.

A paper on the subject presented by Prof. Ira H. Woolson, at the recent meeting at Atlantic City of the American Society for Testing Materials, possesses, therefore, marked interest and value. Although the results of these tests, as indicated by Prof. Woolson himself, are to some extent incomplete and subject to uncertainties due to irregular heating, they acquire much value from their range and scope, the investigations having been made for variations of ultimate resistance and elastic properties, after subjecting the material to temperatures running from 500° to 2,250° Fahr. The mixture used in the cubes and prisms was one part Portland cement, two parts sand and four parts of ¾-in. broken stone, the investigation covering one set of twenty-seven tests of trap-rock concrete and another of an equal number of limestone concrete. It would have been desirable to use larger cubes than those, 4 in. on an edge, and larger prisms than those, 6 x 6 in. in cross section, but the limits of cost and of the capacity of the testing machine used were probably controlling. It is also a matter of regret that older concrete than that having an age of thirty-two to fifty days could not have been employed, for the reason that such comparatively fresh concrete in all probability has a sensibly different fire-resisting capacity from that even one year of age, to say nothing of concrete in buildings several years old.

It is not a matter of surprise that the limestone and trap-rock concretes showed different resisting powers, that of trap rock having a measureable advantage over the limestone. The trap-rock concrete specimens showed no material deterioration after having been heated to 750° F., and cooled two days before testing. On the other hand the specimens of limestone concrete showed a deterioration of practically one-third of their ultimate resistance at 500° F. A compression carrying capacity of about 1,000 lb. per square inch was exhibited by the trap-rock concrete specimens at 1,750° F., while those of limestone showed about an equal resistance at 1,250°, although the latter exhibited a resistance of 800 to 900 lb. per square inch for 1,750° F.

It is clear from these results that, as the maximum load on concrete in engineering structures seldom reaches as high as 400 to 500 lb. per square inch, such structures would not be likely to fail in any great conflagration, in which the temperature probably seldom exceeds 1,750° F., if the concrete were equal in quality to that of the test specimens. At 2,000° F., and above, the limestone concrete cubes practically lost their resistance, while the trap-rock specimens still afforded 420 to 790 lb. per square inch.

As indicated by some subsequent tests by Prof. Woolson, it is probable that the interior of these test specimens did not reach the temperatures accredited to them. There is thus a degree of uncertainty attached to the results, but this uncertainty due to unequal heating has probably made the results too low rather than too high.

The elastic properties of the specimens were lost by the heating and subsequent cooling in every case and rapidly after reaching and passing the 500° mark. Indeed, the loss in modulus of elasticity was greater and more rapid than in ultimate resistance. It is interesting to observe that the loss in physical properties in concrete due to high temperature begins, roughly speaking, at a temperature not far from that at which iron and steel experience a similar loss, although there is probably no significance in the approximate coincidence.

Official Engineering Troubles.

Official service in warm climates is likely to produce a bilious disposition, for which due allowance must be made in considering all complaints from the countries between the two tropics. The true perspective of things becomes warped by the hot sun and the times seem terribly out of kilter. So much has been written about the condition of the engineers of the Public Works Department of India, for example, that anything more would seem to be wholly needless. And yet in a recent number of the London "Times" there was a long article on the subject. After reading it several times the burden of this sad song seems to be about as follows: The Punjab Irrigation Department has expanded enormously since 1893, but it is without enough engineers of certain grades and has too many of other ranks. As a matter of interest it may be stated that on April of this year this branch had two chief engineers, eight superintending engineers, seventeen executive engineers of the first grade, ten of the second grade and thirteen of the third, no assistant engineers of the first grade, sixteen of the second and nineteen of the third, eight covenanted engineers and thirty-eight temporary engineers. Temporary engineers are stated to have little standing officially or socially and poor pay, and the service is so unpopular that it is very difficult to get good men to enter this rank. The permanent positions do not seem to be much sought after and promotion in them apparently goes by some sort of time limit in each rank, regardless of the fitness of a man for promotion before he has served out his allotted time in any grade. Moreover, there seem to be kinks in the pay schedule, for there are assistant engineers getting more than the resident engineers over them, a condition apparently due to different rates of pay for the same service when performed by graduates of different engineering colleges. All these evidences of confused laws and profuse red tape, with the resulting dissatisfaction, are by no means peculiar to India, but it is nevertheless in that country that the complaints seem to be most frank and outspoken.

There are two sides to this matter of service on public works of such importance. The government naturally desires to get just as good men as it can, but its critics prevent it from paying as high salaries as private companies. The correspondent of the "Times" states that the railways are drawing some of the best men from the Indian irrigation service, while in the United States this is a common occurrence. In order to make the service attractive it is necessary for the government to employ some system of civil service. This means red tape, slow promotion and frequently the selection of men who are not the best for the works to be undertaken. It also means a leveling of pay in the various grades of the service, by which the best and the poorest men in each grade receive about the same compensation without much regard to the responsibilities each carries. The better the system of civil service, the more just will be the treatment of the individual men, but no civil service system has yet been devised that is anywhere near perfection. Probably it never will be.

The engineer who enters public service must be assumed to have made some study of the opportunities for advancement before him. He may like the security of an official berth from which he cannot be hauled except for proved incompetency or worse, or he may feel that the glamor of public office will repay him in a measure for the slow progress and limited salary that he will receive for some time. It makes no difference just what is the inducement for entering the service; the important fact is that he must be assumed to have taken the step intelligently, and not through the medium of a press gang. After having joined it, however, he makes a very bad impression by crying aloud on all possible occasions that he is badly treated, and this is a fact that is worth a good deal of reflection, on the Isthmus of Panama as well as along India's coral strand.

A merchant who makes a bad bargain generally keeps just as quiet about it as he can, lest he gain the reputation of being what is commonly termed an easy mark. On the other hand, there seems to be a tendency on the part of engineers to cry just as soon as they find out that they have deceived themselves about the character of an engagement. If promotion is slow they complain; if salaries are unsatisfactory they complain some more, and if anybody pays them much attention they drop everything to talk it all over from alpha to omega. This hurts the engineering calling very much, reducing it in the eyes of some people to a sort of unorganized labor union. Men in business, when they find themselves in an unsatisfactory position, hunt up another, but for some reason men in an unsatisfactory engineering position ask the public to observe that they are not properly appreciated. There is nothing about an engineering education warranting its fortunate possessor in thinking that he is outside the law of supply and demand. If he does not like his work he ought to find something else to do just as fast as he can, for the chances are that he is not doing his employer justice so long as he is disgruntled. He is not kept in a state of peonage, and when he complains publicly about the hard lot of the engineer there are a great many people engaged in engineering who deeply hope that the earth will open and swallow him up before he brings too much discredit on the calling.

The Street Traffic in London.

One of the most important reports made public in a long time is that of the Royal Commission on London Traffic. This commission was appointed somewhat over two years ago for the purpose of investigating the methods of transportation in Greater London and the advisability of establishing a central tribunal which should pass upon all projects for railways of any sort in the metropolitan area. The mere fact that the importance of the subject of street traffic has led to the appointment of a Royal Commission ought to carry great weight with the authorities of large American cities. Indeed, it may be said that the street arrangement in almost every large city which developed rapidly in the last century presents many problems of deep importance. Means of transportation between important centers are often limited by the inadequate facilities for constructing street railways, the streets are often too narrow for even the wheel traffic that is jammed into them, and the sidewalks are allowed to be used as warehouses by the abutting property owners.

The situation in Greater London is not particularly unique, for it can be matched on a smaller scale in Boston and Chicago, in this country. Greater London has an area of 692 square miles, and a population of 6,500,000. The number of rides per capital per annum of this population is about 200, as compared with 300 in New York and 270 in Berlin. As the working classes move from the crowded central districts into the suburbs it is probable that the rate of rides per capita will increase, provided the transportation facilities are increased to correspond. The increase in these facilities will be very expensive, because of the manner in which the existing street plan developed. The ideal plan, according to the commission, is the construction of railways for long-distance urban traffic, others for suburban traffic into and from the city, the connection of all tramways and railways for the rapid interchange of passengers, the widening of existing streets, the construction of new thoroughfares, and the regulation of street traffic. All form parts of a single problem.

The importance of these suggestions lies in their recognition of the fact that at the present time the street itself is only one part of a system of transportation, and that any street planning which fails to take into account the tramway and other railway systems is bound to be one-sided. As a matter of fact, in our large cities the street itself in some districts does not compare in importance as a means of transportation with the railways and the elevators in the buildings. The problem is no longer one of mere streets, but is rather one of transportation, and when viewed in this light is seen to demand a very careful investigation of the tendencies toward future development. The widening of a street which does not need this improvement, the failure to widen others which eventually become congested by the travel through them, the injudicious location of costly railway lines, all these subjects are so bound up that they must be solved together or the public will suffer.

It is also necessary to understand the very costly nature of important street improvements at the present time. New York has had some chance to learn this in the widening of Elm Street, but the expense of that work is nothing to the probable cost of two new thoroughfares which are suggested for Greater London. One of these runs 4¾ miles east and west to connect Bayswater Road with Whitechapel, and the other runs 4½ miles north and south to connect Holloway with the "Elephant and Castle." Each of these great avenues is to be 140 ft. wide; provision is made for subways in which to place all conduits, as well as four lines of underground railways, while on the street above there are four railway tracks. The east and west avenue is estimated to cost about £15,550,000 and the other about £8,550,000. These projects are not put forth as necessary at present, but rather as indications of what must be done for a really perfect solution of some of the traffic problems. For the present, it is believed, work should be confined to the improvement of congested places in the present system of streets, "preference being given to such improvements as are indispensable for the development of a complete system of tramways throughout London." This is a new note in street improvement discussion, but it is of great importance.

Personal Transportation in Factories.

The importance of adequate facilities for the transportation of raw materials and products has long been appreciated by factory managers whose eyes are open to ways and means of securing greater economy of production. It is exceptional to find a large industrial establishment in these days not equipped with tracks, elevators, traveling cranes and hoists in various parts of the works to hasten the movement of materials of all kinds at every important stage of the manufacturing process. Modernizing engineers have paid close attention to these points in works under their examination, and the stop-watch has played a useful part in securing the data upon which not a few suggestions have been made.

With the constantly increasing acreage occupied by the larger manufacturing plants the problem of saving employees' time is coming more and more to the front, and although comparatively little, if anything, has been done to provide horizontal personal transportation in factories, the time is not far distant when the matter will have to be seriously considered. Already plants are in operation where some of the buildings are from two to five thousand feet from the offices, and it is probable that the development of the early future will produce a still greater degree of inaccessibility. The vast majority of employees in great industrial plants like the General Electric Works at Schenectady, or the Allis-Chalmers factory, at Milwaukee, are stationed in very limited individual quarters throughout their working hours, but in all such works of vast area and many buildings there necessarily is a great deal of personal travel on the part of the office force between headquarters and the various departments of the factory. The telephone has reduced beyond computation the amount of time wasted in walking, and the elevator helps solve the problem of vertical transportation, but something more than these will be needed before long, if, in fact, the situation does not call for improvement to-day. The time of the higher-salaried employees is too valuable to be frittered away by several half hours' walking per day between various parts of a plant, and if a study should be made of the annual cost of such time in any of the larger modern factories, it is probable that the total figures would be surprising. Incidentally, the Boston Elevated Railway Company has recently purchased an automobile to enable one of its motive power officials to cover the various car houses and shops upon its system more quickly than is possible with a horse and carrriage or by street car, and it has already been found that several times as much work is accomplished per day as under the old regime. Whether the automobile, the traveling sidewalk, the bicycle, or the intramural trolley will best solve the problem in very large factories remains to be seen in individual cases, but that some improvement in these conditions will shortly declare itself is not improbable.

Notes and Comments.

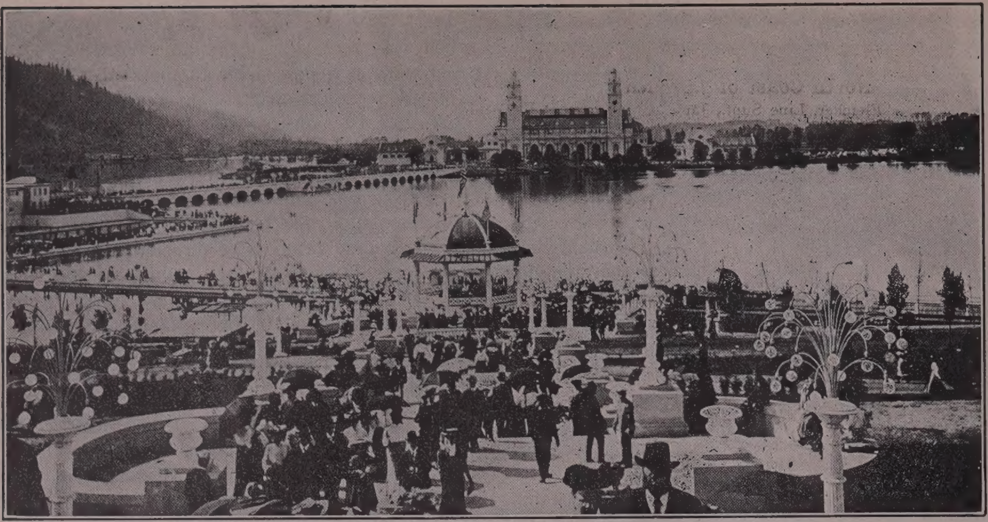
THE TELEPHONE MONOPOLY in New York City has been carefully investigated by the Merchants' Association. After a study of the company's expenses and improvements now in hand, the Association's committee reports that the system of the New York Telephone Co. is unsurpassed for adequacy and efficiency, that rates are reasonable and the schedule of charges is equitable. This is high praise, indeed, from such an organization.

THE SUCCESSFUL TEST of the first lot of armor plate made by the Midvale Steel Co. is a matter of more than common interest. It has been generally held that it was idle to expect the discovery of any process capable of producing such plate of a quality equal to that of the established manufacturers. Even if such a discovery were made the probability that it could become commercially successful so that large deliveries could be made on time was considered still more problematical. The events leading to the recent tests at Indian Head show that not only is the Midvale Co. able to make good plate, but is also able to turn it out on time, and it is important to recall in this connection that the company's contract was taken at a considerably lower figure than the prices in the tenders of the Carnegie and Bethlehem companies, which have heretofore had a monopoly of this business in the United States.

THE NAVAL POWER PLANT CONSOLIDATION which was ordered some months ago has been progressing backward with all the sloth that was expected by those acquainted with the department's official politics. The report of Messrs. Stone and Webster advising the consolidation of all such plants in each yard was reviewed at length in this journal when it appeared. Their recommendations were adopted by the Secretary and the bureau heads were directed to formulate their ideas concerning the method of carrying out the recommendations. Each bureau was averse to giving up its own plants and accordingly nothing was done until the Secretary solved the deadlock by turning the whole matter over to the Bureau of Yards and Docks. Since then there has been nothing accomplished because the bureau named can secure no co-operation. Finally the Secretary has become disgusted and has ordered the consolidation to begin forthwith, commencing at the Brooklyn yard, where a partial project costing $175,000 has been outlined. It is to be hoped that the Secretary will be able to carry out his ideas, for the present condition of power plant matters in the various yards is a farce, on account of the jealousy of the different bureaus concerning their prerogatives. It would seem as though each bureau guards its secrets more carefully from the other officers of the Navy than from the outside world, and would rather haggle over its right to boss some particular machine than to encourage a good feeling in the whole department and bring about that spirit of unity which is so evident in the Japanese Navy and is so pitifully lacking in our own.

THE POLICY OF SECRECY which the Pennsylvania R. R. has enforced with respect to the construction of its New York City improvements has had some weird results in the newspapers. Nothing makes a city editor so insistent on news as a refusal to give it, and accordingly the local papers have been printing some remarkable stories about what was taking place on this undertaking. The latest is the announcement of a "cement mine" in the tunnel under East Thirty-fourth Street. It was gravely stated lately that the fact of the discovery of this mine had been kept quiet and would have remained a secret for a long time had not a large quantity of the cement rock been thoughtlessly exposed to view on the surface. The whole thing is wrapped in mystery, but the lid was lifted long enough for one enterprising reporter to learn "that it looked as though enough cement rock would be taken out to pay a good share of the cost of excavating that part of the tunnel."

THE SOO CANAL was fifty years old this summer, and the fact has been suitably celebrated at Sault Ste. Marie this week. Before the opening of the canal there was a tramway around the rapids on which wagons were hauled by horses, and by this laborious means a small quantity of iron ore had been shipped from the Lake Superior region. Mr. Schwank states that the first shipment of this nature was one of about five tons in 1850, to A. L. Crawford, of Newcastle, Pa. Three years later a few tons were sent to the World's Fair in New York. The business in Lake Superior ore did not amount to anything until 1856, when the completion of the canal enabled 36,343 tons to be sent East. At the present time the two locks on the American side of the river are fast becoming inadequate for the enormous traffic coming to them, and there is urgent need of the construction of a third lock. It is proposed to build this north of the existing canal, and the construction will involve some unusual and important engineering problems, owing to the topography of the site.

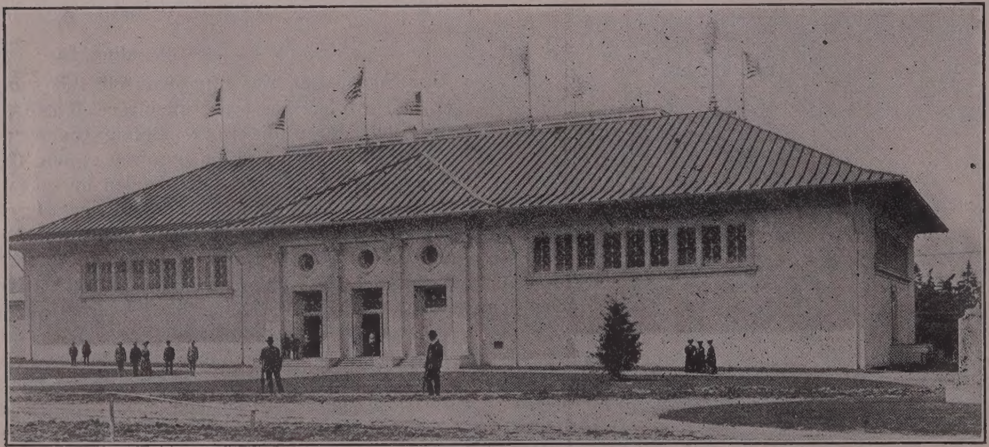


The Government Buildings and Connecting Bridge.

BUILDINGS AT THE LEWIS AND CLARK EXPOSITION.

The Lewis & Clark Exposition at Portland, Ore., is attracting more attention from Eastern people than was expected by the managers, although this is not at all surprising when it is considered that at the present time no part of the country is considered so full of promise, commercially. Now that the United States includes territory in the Far East, the Pacific coast becomes but a transfer point for Hawaii and the Philippines. The exposition at Portland, while commemorating one remote step in national expansion, really concerns great events in the immediate past as well, and their importance is so great that the exposition is merely one of the attractions which are drawing so many people to the Pacific coast this summer instead of to Europe. The exposition itself is well worth the transcontinental trip, for it is essentially a display of the local products of the coast country. It is beyond the scope of this article to describe these, as it is intended at this time to take up only some of the leading architectural features of the exposition.

The site is a tract of 190 acres on a lake of nearly 300 acres, which divides the grounds into two portions connected by a monumental bridge. On the south side the land rises to an elevation of 100 ft. above the lake and here the important buildings have been located and a park laid out. Across the lake are the government buildings.



The Mines and Metallurgy Building.

The United States Government buildings are five in all, the main structure being connected with three smaller ones by ornate peristyles, while the fourth smaller building, the United States Life Saving Station, is located west of the group, on the shore of the lake. The front of the main building is spanned by five arches, each 40 ft. wide, supported by Corinthian columns 44 ft. high. The building is graced by two towers, each of which is 260 ft. high and surmounted by a dome. The roof of the main building is arched, the highest point being 130 ft. from the ground, while at each end is a half dome. Constructed in the Spanish Renaissance style of architecture, in harmony with the other main exhibition palaces, the building is, from an architectural standpoint, one of the finest in exposition history. The space between the building and the lake shore is occupied by green lawns. The Territorial pavilion is located to the east of the main building, and the Fisheries pavilion to the west, the Irrigation building being behind the latter. The minor buildings are in the same style as the main structure, but they have less ornamentation.

The Mines and Metallurgy building is 200 ft. long by 100 ft. wide, and contains 20,000 sq. ft. of exhibit space. It is covered with decorative staff, which has been tinted a pleasing gray, restful to the eye. Decorative effort has been expended principally on the main entrance, located in the center of the south facade. Three wide doorways are separated and flanked by fluted pilasters with Ionic capitals. The windows of the building, except a few over the doors, are set high up on each of the four sides and are composed of a number of small, ground glass panes. Overhanging eaves, made wider by the fact that underneath them the walls swell out for a considerable distance, produce an unusually attractive effect.

The Mines and Metallurgy building has an addition 30 ft. wide by 60 ft. long, which extends across part of the west facade. The addition was necessitated by the unexpected requirements for space in which to house the unusually attractive displays from the Oregon mines. Near the opposite end of the building, a pavilion popularly known as the Black Sands Annex, has been erected for the purpose of enabling the United States Government to carry on some very interesting experiments with machinery designed to remove the minerals from the black sands of the Pacific coast.

The Machinery, Electricity and Transportation Building.

The longest building on the exposition grounds is that devoted to machinery, electricity and transportation, which has a length of 500 ft. The main building is 100 ft. wide, but at each end, where projecting wings 100 ft. square are added, the width is doubled. The wings were made necessary by the unexpected demand for exhibit space on the part of large manufacturing concerns. The building is a plain structure, with comparatively little attempt at ornamentation. A red hip roof covers the building with the exception of the wings, which are flat-topped. Decorative efforts have been confined almost entirely to the main entrance, which is located in the center of the west facade. The entrance is through an arch onramented with flanking pilasters, a cornice of liberal projection supported by classic brackets adding to the attractiveness. Above the cornice, an extending wall is adorned in the center by a star window, and at each angle supports a pinnacle and flag staff.

The Forestry building is the unique structure of all expositions. It is a gigantic log house, exemplifying in its composition the forest wealth of Oregon and Washington. Besides being a timber exhibit itself it will contain all the finished products of the forest as well as the woods in their native state. In its construction two miles of 5 and 6 ft. fir logs, eight miles of poles and tons of shakes and cedar shingles were used. The logs have been left in the rough with the bark on. The base logs of the building are 6 ft. in diameter and 52 ft. long. The logs above the base are 3 ft. through and vary in length. Colonnades of immense fir trees 30 ft. high and 6 ft. in diameter support splendid loggias or galleries over the main entrances. Picturesque balconies grace each end of the building. The portico over one entrance is supported by giant spruce trees and the other shows a colonnade of magnificent hemlocks. The upper part of the building is supported by cedar bark shingles laid 18 in. to the weather. An overhanging roof adds much to the attractiveness of the structure.

The interior of the building as well as the exterior will be an exhibit of the forest wealth of the Northwest. Here a colonnade of 52 columns of fir and cedar trees 40 ft. high supports the roof. Rustic stairways and inside balconies running around the entire building enable the visitor to study the display of native woods and other forest products.

In the construction of the Forestry building, no carpentry work was employed, the logs being framed together with tree-nails and old-fashioned wooden pins. The trees used were cut in the forests bordering on the Columbia River. They were formed into rafts and floated down the Columbia and Willamette rivers into the lake. From the lake they were raised to the site of the building in Centennial Park by means of a skidway 1,500 ft. long. The distance traveled by the logs in the water was 75 miles.

The Forestry Building.

The grounds, buildings and parks are lighted by incandescent lamps, 7,000 of them being required for the park alone. All the buildings are outlined with frosted 8-c.p. lamps, and the roadways and bridge have post electroliers which are shown in the view of the government building. The design and installation of the lighting equipment has been under the direction of Mr. James R. Thompson, current being furnished by the Portland General Electric Company, whose president, Mr. Henry W. Goode, is also president and director-general of the exposition.

THE ST. OUEN POWER PLANT of the Paris Metropolitan Ry. has marine type water-tube boilers and four Brown-Boveri-Parsons 5,000-kw. turbines. In the boiler room the space is utilized at the rate of 0.88 kw. per sq. ft., as against 0.25 kw. in the Bercy station, containing Corliss engines. In the engine room the space is utilized at the rate of 1.43 kw. per sq. ft., against 0.72 kw. in the Bercy station. It should be added that the St. Ouen Station has been designed with a view to securing the maximum utilization of space.

Some Notes on Sea Protective Works on the North Coast of Jamaica.

By J. Monk Fletcher, Line Supt., Jamaica Government Ry.

For 25 miles the railway which connects Kingston, the capital of the island, with Port Antonio, the chief fruit shipping port on the north side, runs very near the north coast and in many places actually upon it. This coast is exposed to the full force of the northeasterly and north winds, which blow almost continuously throughout the year and frequently increase to storm force. There is consequently a constant erosion of the coast line taking place, which has necessitated from time to time sea protective works.

During the hurricane of August, 1903, which caused such extensive damage throughout the island, many of these protective walls, which rested simply upon sand and gravel, were destroyed or seriously damaged and had to be repaired and replaced, which, together with the new works required, entailed the expenditure of nearly $20,000. The work was generally of an ordinary character consisting of a foundation of concrete, composed of one part Portland cement, three of sea sand and six of sea gravel mixed with sea water, carried up from solid clay or rock at distances varying from 2 to 8 ft. below sea level to 4 ft. above sea level, with a wall of masonry of the height and thickness necessitated by the height of the bank which it was to protect. This has been found to be in most instances a sufficient protection, though in some cases the addition of a few groins for the purpose of collecting the shingles upon the beach is desirable, as, the prevailing winds being northeast, the shingle is constantly carried past the northwestern extremity of the island.

The sea protective walls, of which some 2,000 lin. ft. were built, were usually placed at or about ordinary high-water mark, and little trouble was experienced from the sea except during storms, when, of course, much of the timbering was washed away, the excavation filled up, and all plant had to be removed to prevent loss.

At one portion of the coast, however, the railway is carried partly on a ledge cut along the face of a perpendicular cliff nearly 200 ft. high and partly through tunnels driven through the same cliffs. There are three short tunnels, in all 520 yd. long, and 700 lin. yd. of rock cutting within three-quarters mile, and rail level is at a height of 40 ft. above sea level.

The rock is of igneous nature, very much broken up by volcanic action and by excessive charges of explosives during construction, and is rapidly eroded by the combined action of the sea and gravel beating against the foot of the cliff. The bed of rock under the sea slopes rapidly, making an angle of 160 deg. with the horizon, so there is deep water 30 ft. from the base of the cliff. At the foot of the cliff there is usually a covering on the rock bottom of 2 ft. of sand and gravel, mainly gravel, and in very calm weather there is just room to walk along the shore at the base of the cliffs.

The sea beats against the face of the cliff on an average 28 out of 30 days, and it carries with it the gravel which, being composed of stones brought down by the rivers, is of a much harder nature than the cliffs. The consequence is that the base of the cliffs is cut away and frequent examinations and repair works are necessary to prevent the undermining action of the sea from assuming dangerous proportions. A few years ago an examination was made, and it was discovered that a large cave extends for some distance underneath the track. It was, of course, filled up and a protective wall built across the entrance. From time to time other pieces of wall have been built, and the total length of protective walling at this place is now 360 lin. yd.

In January, 1904, during an exceptionally heavy "norther," a portion of wall 44 yd. long was washed away and the sea endangered the track running along the edge of the cliff 40 ft. above. It was necessary to replace the fallen wall by a stronger one, and this work, although not extensive, was, owing to the peculiar conditions, very difficult and costly.

In the first instance it was decided to build the wall of concrete, composed of one part of Portland cement, three of sea sand and six of sea gravel, and, as the work was to be carried out below high-water mark and there are practically no tides, it was necessary to furnish some protection for the men and the work. Guide piles 6 x 6 in. in size were driven into the sand and gravel, and, as they could not be driven farther than 2 ft., at which depth they rested upon rock, they were set in concrete at the foot and the heads were braced against the cliffs. Six-by-four-inch walings were then notched and then bolted to the piles inside and outside, and 6 x 2-in. sheet piling was driven down between to form a protection for the men and a boxing for the concrete. All the work had to be done during heavy seas.

This timbering was found to stand the ordinary seas, but after one-half the work had been done a strong "norther" arose which washed away the sheet piling and broke off the waling, leaving the guide piles intact. The timbers were replaced by stronger ones and the work was completed.

The wall is carried up from solid rock, varying from 2 to 5 ft. below sea level, to a height of 15 ft. above sea level, and is built with a batter of 1 in 3. The thickness of the bottom is 7 ft. At the back of the wall is a filling of loose rocks rammed with broken chalk stone back to the comparatively solid cliffs, and on the top of this filling is a sloping pavement of 12-in. thick rubble set in 1 to 5 cement mortar, sloping at an angle of 150 deg. with the horizon and running back for a horizontal distance of 18 ft. A dry rubble wall 6 ft. thick, with the front 18 in., built in 1 to 5 cement mortar, is built on the top of the rammed filling against the face of the cliff to protect the latter from erosion due to rain and atmospheric influences and prevent further slips, the rock being in many places very badly cracked and rotten.

Continual strong winds and heavy seas prevented any examination of the work for nearly three months after it was completed. At the first opportunity an investigation was made, and it was found that the concrete along the whole of the new work was cut away by the action of the sea and gravel to a depth of over 3 ft. This was again repaired, but it was found that the concrete was again cut away very quickly, it being impossible to provide at any reasonable cost a sufficient protection until the concrete became hard enough to resist the grinding action of the gravel thrown by the sea against the wall. It was also found that other and older concrete walls were showing considerable signs of erosion. Under the circumstances it was decided to discard concrete in favor of masonry, and, as the weather was still heavy, rendering repair work almost impossible, and the erosion was proceeding rapidly, it was decided to place large blocks of hard limestone, each containing about 2 cu. yd., at the foot of the wall to act as a breakwater. These were cut out of the quarry, loaded on flat cars by a derrick crane temporarily mounted on another flat car, transported to the site and lowered into position by means of the same derrick car. These answered the purpose for which they were intended, viz., the prevention temporarily of further erosion, and also formed a protection subsequently for the men engaged in repairing the wall.

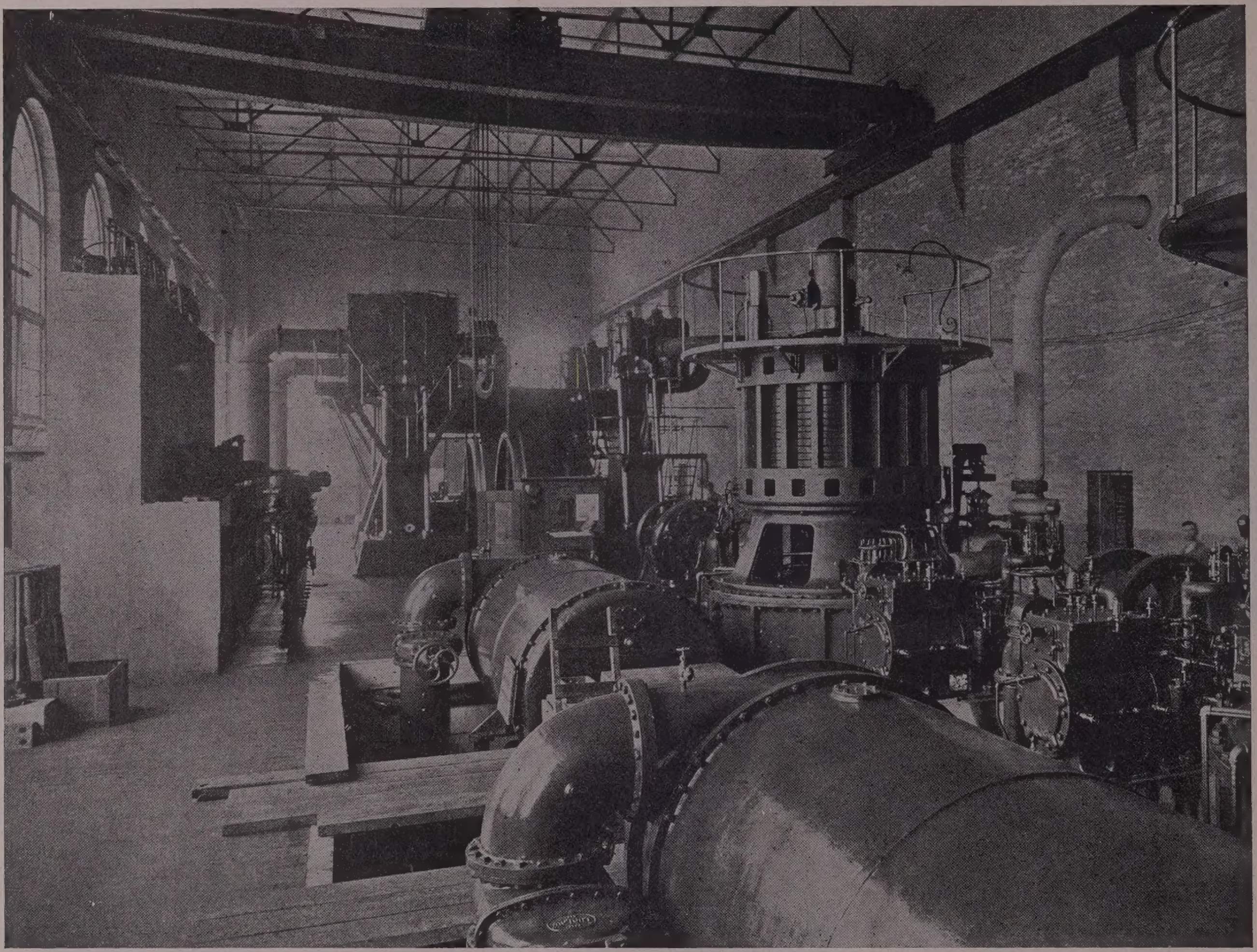
The wall was eventually repaired piecemeal in rough rubble masonry of hard limestone, set in 1 to 2 cement and gravel mortar, the gravel being of ¾ to 1¼-in. gauge and mixed with very coarse sand. The stones were left rough on beds and edges to form a stronger key for the mortar. As the work was completed it was protected temporarily from the sea by 2-in. planks laid longitudinally with uprights outside, with larger boulders against them. In six hours' time the work was properly set and the boxing could be taken away.

An examination made three months later showed that the stones wear well and the cement mortar is harder now than when the work was completed, practically no erosion having taken place. The coarse mortar wears well, being almost without sand and consequently very strong.

The cost, on an average, is $6.50 per cubic yard for labor and material, the labor being day labor and the cement imported at a cost of $2.25 per barrel. From start to finish the work of rebuilding and repairing this wall occupied 15 months, it being sometimes impossible to work for a month at a time in consequence of the heavy seas.

Electric Power Plants of Portland, Ore.

In the article elsewhere in this issue on some of the buildings at the Lewis and Clark Exposition, mention is made of the fact that the electric current for the Exposition is furnished by the Portland General Electric Co. This corporation was organized in 1892 and shortly thereafter acquired the valuable water power and canal companies at Oregon City, together with all of the electric light and power companies operating in and about Portland and Oregon City, Ore. The company furnishes about 3,000 kw. of the power necessary for operating the Portland Consolidated Railway's 120 miles of electric road; for driving the Portland Flouring Mills, the largest on the Pacific coast, and a part of the power for operating the 100-mile system of the Oregon Water, Power & Railway Company's interurban road connecting Portland, Oregon City, Canemah and Cazadero; and it also furnishes the public and private lighting for the city of Portland. In this connection it would be interesting to state that an order has just been placed for a new street lighting system employing magnetite lamps, supplied with direct current secured from mercury-arc rectifiers and constant-current transformers, direct from the three-phase, 33-cycle, 10,000-volt, primary transmission system.


Interior of the New Station of the Portland General Electric Company.

The generating plant of the Portland General Electric Company consists of two principal stations, one located at Oregon City, about 14 miles from Portland, and operated by water power from the falls on the west bank of the Willamette River, and the other a large new steam plant fully equipped with modern steam engines of both vertical and turbine types, situated in the city of Portland.

The present installed machinery capacity of the water power plants is 8,600 electric horse-power, and of the steam plants 10,000 h.p., or a total of 18,600 electric horse-power. The company's ability to derive a large percentage of its power from water, enables it to generate current at minimum cost. During the last two years the company has expended nearly $1,000,000 in increasing the capacity of its plants and in the unification and improvement of its water and steam units, substation and distributing systems. As soon as occasion requires, it is proposed to construct another water power plant on the east bank of the river at Oregon City, of an ultimate capacity of 30,000 h.p.

The new steam station above referred to as fitted with modern generating apparatus, is located in Portland, on the Willamette River, from which it secures an abundant supply of water for condensation purposes. Owing to the very great rise and fall of the river during times of freshets, when the waters of the Columbia River back up, thereby increasing the water level at Portland about 25 ft., special provision had to be made for supplying condensation water. A large water-tight, concrete pit (60 by 20 and 30 ft. deep) was built, and in this and at the level of low water, were placed engine-driven centrifugal turbine pumps, this arrangement at all times insuring a steady supply of condensing water, independent of the river level. The change of this river level of about 25 ft. is expected each year, and the shipping district along the river front provides two-story warehouses and docks for the handling of their business. During the high water period all business is done from the upper floor of the docks and warehouses, and during low river period from the lower floor.

The station building is of brick with concrete floors and iron truss roof and is practically fireproof. As the plant is in the neighborhood of sawmills and frame buildings, special provision has been made to guard against fires from the exterior by means of water tanks, fire pumps, etc.

The boiler plant consists of five batteries of Cahill water-tube boilers, each battery rated at 1,040 h.p., with a concrete and steel stack 230 ft. high and 12 ft. inside diameter; two 1,400-h.p. marine type vertical compound engines built by the Willamette Iron & Steel Co., each engine direct connected to a 1,000-kw. generator; one Ideal engine exciter of 85 kw. capacity; two Curtis steam turbines, each rated at 1,500 kw.

Provision is made for the operation of the plant by the use of sawdust from one of the large lumber mills or by fuel oil, and the change from saw dust to fuel oil, and vice-versa, can be made so quickly that it is unnecessary to extinguish the fires or to reduce the steam pressure on the boilers.

The larger part of the current is generated at 11,000 volts, three-phase, 33 cycles, which is the same type as that supplied from its station at Oregon City.

The power from both the hydro-electric plant at Oregon City and the steam plant at Portland is delivered to a sub-station located in the center of the city. This sub-station contains rotary converters, static transformers and motor generator sets by which the energy is prepared for distribution either in the form of direct-current 550 volts for the railways or 2,300-volt, 60-cycle current for general distribution. Very large customers, such as the Portland Flour Mills, etc., are supplied direct from the 10,000-volt, 33-cycle transmission system. The capacity of the sub-station is about 10,000 kw. A special sub-station has been built for the Exposition service. The current is three-phase, 33 cycles, 10,000 volts, and is carried to the sub-station and changed by static transformers to 2,300 volts for lighting.

Heavy Electric Traction.

Electric railway operation has one drawback, sometimes overlooked, which was pointed out by Mr. A. H. Armstrong at a recent meeting of the American Institute of Electrical Engineers. With 3,300 volts at the sub-station, it is possible to operate heavy suburban cars at speeds approaching 50 miles an hour on from thirty to sixty minutes headway, with substations placed fully 20 miles apart, assuming that they are tied together. It is a question, however, how much trolley line should be rendered liable to disablement in case of accident. Twenty-mile blocks are long enough for satisfactory operation, Mr. Armstrong believes, and a higher trolley pressure, permitting a greater distance between sub-stations, he considers an unwarranted refinement. This matter of reliability in operation is a very important one in any discussion of the electrification of steam lines. As Mr. H. W. Buck stated in another Institute paper, if a steam locomotive breaks down, as frequently happens, probably only one train is stopped. The simultaneous breakdown of every locomotive on the division, involving a complete interruption of traffic, is improbable. With electric operation, on the other hand, an accident in the power house or in the distribution system will stop every wheel.

The Terminal Railroad Improvements at St. Louis.

The railroad situation at St. Louis is an unusual one, for it is the largest experiment in joint railroad management, both freight and passenger, now in progress. Possibly more carloads of freight and more passengers may be handled at other terminals, but at St. Louis more railroads have their terminal operations handled by one agent than is the case elsewhere. At one time it seemed as though the Terminal Railroad Association would prove a costly failure. The congestion of freight on both sides of the Mississippi became almost continuous, while the exasperation of passengers detained within sight of the Union Station for periods sometimes exceeding an hour was a standing joke among traveling men. There were many railroad managers who felt that the plan of concentrated control was a failure, but the investment in the terminal improvements was so great, and success so important, if it could be attained, that the association decided to attack the problem in detail and solve it if a solution were possible. This difficult task has been accomplished and in the "Journal" of the Association of Engineering Societies there has recently appeared a most interesting paper by Mr. Daniel Breck, chief engineer, read before the Engineers' Club, describing in a general way the large features of the problem and the way they have been treated.

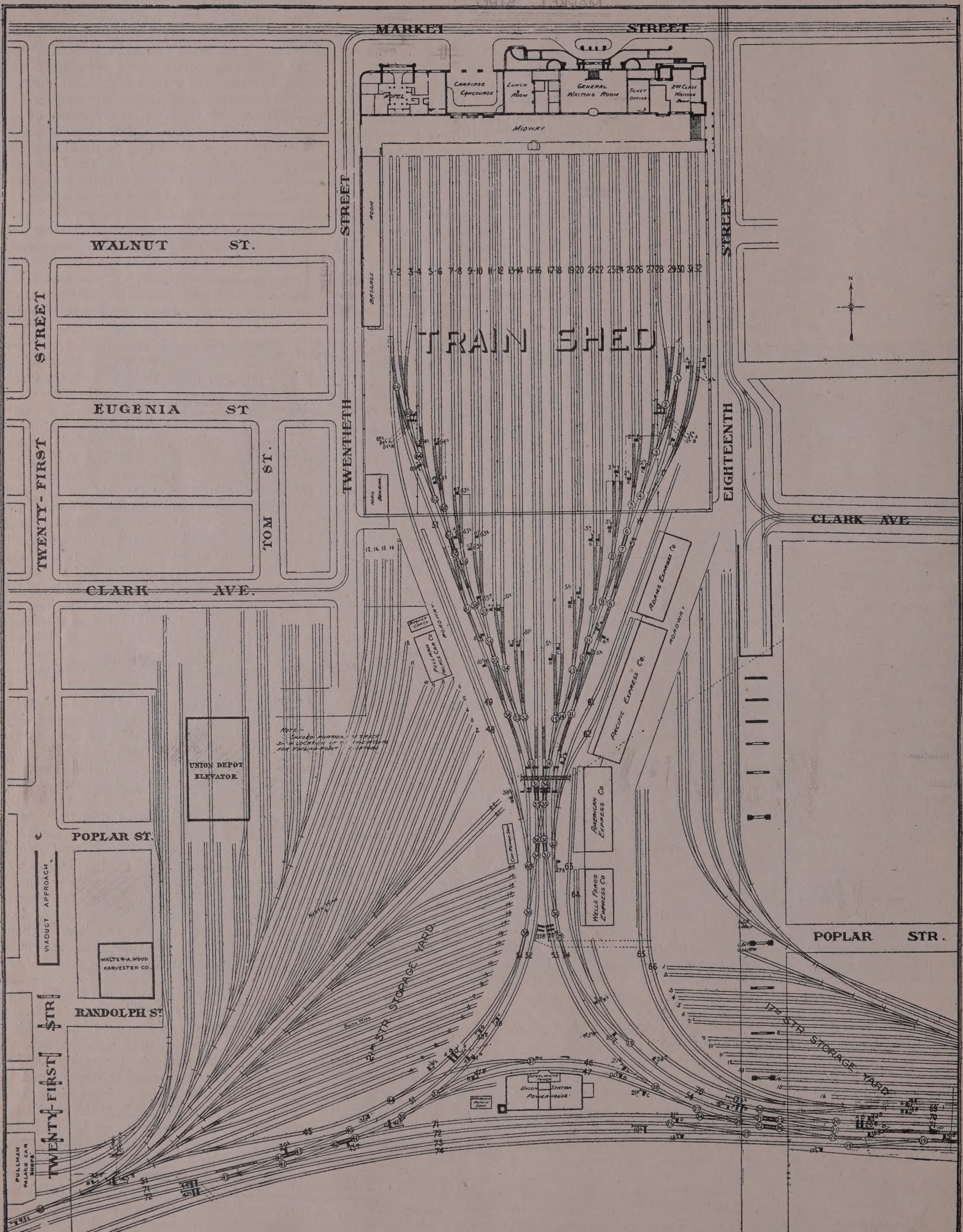
The first phase of the trouble, he stated, was a lack of good internal circulation, of lines of free, uninterrupted movement through the property itself. There must be main lines for free movement from all outlying parts of the property direct to the Union Station, as well as lines connecting important points within the terminal territory. These main lines must be kept open for movement, and every device that was known to expedite movement must be adopted to increase the efficiency of these lines. Therefore, at the thirteen important and complicated crossings or junctions of these lines with themselves or with the lines of the various individual railroad companies, elaborate interlocking plants were established, requiring a total of 976 levers, and along the main lines wherever movement could be expedited in that way, the lines were equipped with automatic block signaling in such a way as to give continual notice to trains as soon as the lines were cleared for them to proceed. Almost everywhere the movement called for at least double-track main lines. At many points three and four tracks were provided, while at the point where the passenger train movement was most concentrated, opposite the Union Station, seven lines of main track, one for freight and six for passenger movement, were provided. This, together with yard rearrangements, required the building or rebuilding of over 138 miles of track.

The Eads and Merchants bridges were taken into consideration under the general heading of this main line movement. It was found that both these bridges required strengthening of many members in order to put them in condition to carry the heavy engines now in use. The Eads Bridge was strengthened so as to take an increased load of 20 per cent, and the Merchants Bridge an increased load of 30 per cent. Obviously all power must move freely over these bridges unless they were to present serious obstruction to proper movement, as the selection of light power and attaching it to trains before they could move over the bridges would cause confusion and delay. Furthermore, if a light engine can take only 25 carloads over the bridge and a heavy one could take 50, the number of movements would be doubled if light engines must be used exclusively, and thereby the number of movements, already too great, would soon have exceeded the capacity of the tracks.

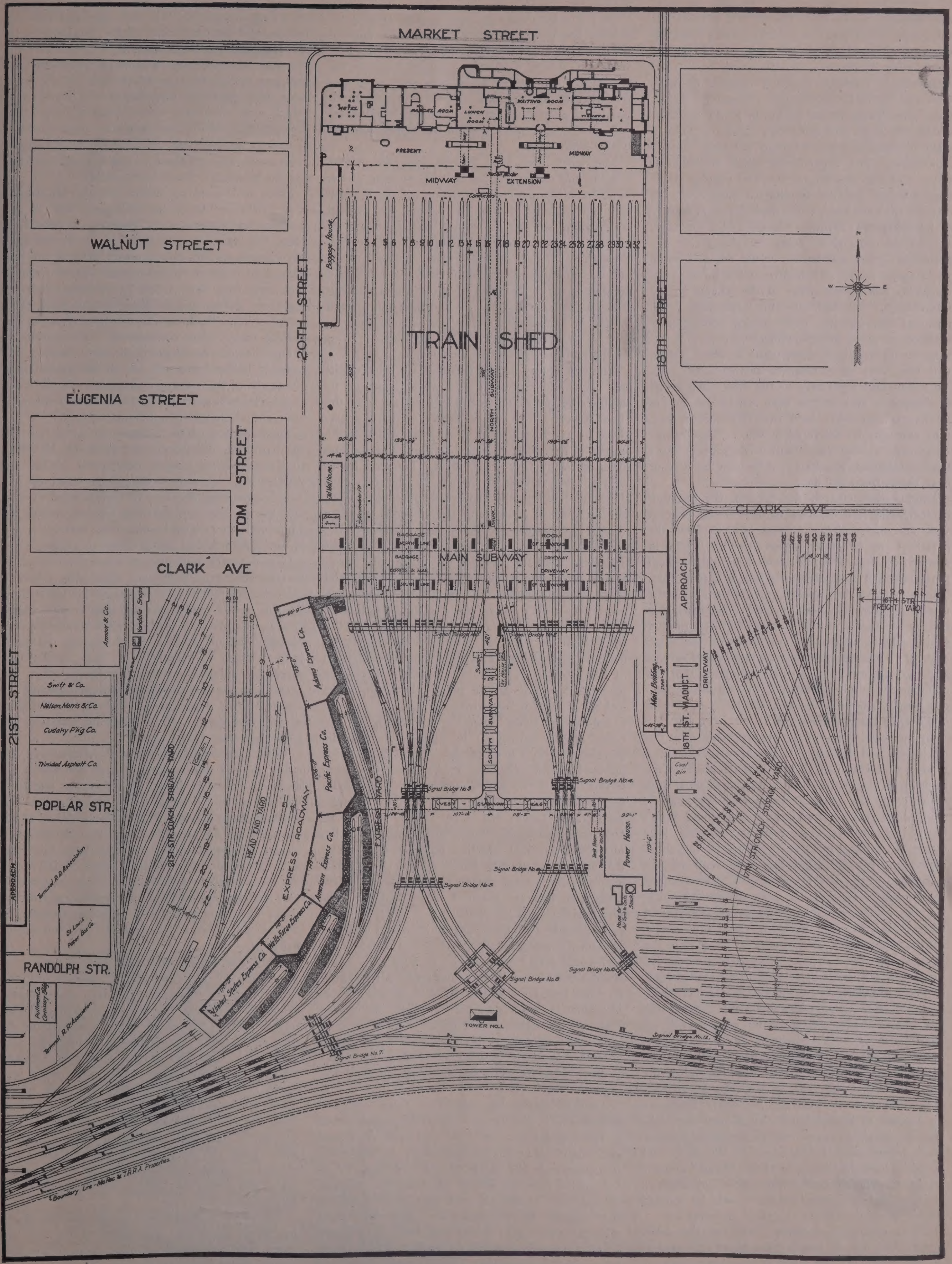
The tunnel at the west end of the Eads Bridge offered still further obstruction to free movement. Two interlocking towers, one at the east end and one at the west end of the tunnel, although placed as close to the end of the tunnel as they can properly be, are about 1.1 miles apart, and the time required by a train to clear the distance between them is approximately four minutes. In addition to other incidental disadvantages of operating in this tunnel, there is a sharp curve, nearly 12 deg., about midway in the tunnel, and the section of the tunnel is so small as to prevent the proper elevation of track to allow for a high-speed movement around this curve. Furthermore, for the most obvious reasons, the tunnel is operated under what is known as the absolute lock and block system; that is, one train cannot enter the tunnel until a train preceding it on the same track has gone entirely through the tunnel and come out at the other end. This protection is secured by a system of interlocked signals requiring the concurrence of the operators at both ends of the tunnel before train movement is allowed through the tunnel. As easily seen, the result of this is, that only fifteen trains can use the tunnel in each direction per hour, and as there were times both morning and evening when trains were leaving and arriving at the station at the rate of 89 trains in 60 minutes, those destined via the tunnel even came to a greater number than 15 per hour. The Merchants Bridge was, however, not being worked to its full capacity; so the main lines were made to include an opening up of routes in such a way that traffic which had been going over the Eads Bridge could be, if necessary, diverted over the Merchants Bridge. In this way, even high-speed passenger trains, which formerly ran through the tunnel and over the Eads Bridge, were made to take the comparatively circuitous but relatively high-speed line over the Merchants Bridge, with the result that the loss of time was only from three to five minutes over schedule, while the actual loss of time which might have amounted to an hour or more was saved.

Following the construction of the main lines, the next thing was to provide largely increased freight storage and switching facilities to care for the large daily volume of freight cars handled within the yards and keep the main lines clear. In accomplishing this a great deal of new construction and rearrangement was necessary in the switching yards. Independent drill tracks were provided in numerous cases, where the yards had been drilled on such main lines as then existed. Among the first work of this kind undertaken was the construction of an artificial gravity or "hump" yard at East St. Louis. In order to get accurate data as to the amount of switching actually done in this yard, an accountant was stationed near the drill track, and the actual time when each cut of cars began to pass, the number of cars, and the time when the last car was switched, was set down. From the data thus obtained it was learned that the switching capacity of a yard of this character is not less than 100 cars per hour with a percentage of 80 switches to each 100 cars, almost every car in this switching having a different destination. Apparently this rate could be maintained throughout the 24 hours if the yard were large enough. The tracks of this yard, however, were not long enough to get the full benefit of the rapid switching, as the shorter tracks were very quickly filled up, and until they could be emptied the switching must be stopped. Various alterations were made to separate and untangle conflicting lines of movement at the entrances to the various yards, and the yards in many instances were sub-divided by constructing more than one drill track, thus enabling more than one engine to work at one time without interference one with another.

On a terminal property like this the question



ORIGINAL PLAN OF TRACKS AND BUILDINGS AT THE UNION STATION AT ST. LOUIS



PRESENT PLAN OF TRACKS AND BUILDINGS AT THE UNION STATION AT ST. LOUIS of interchange tracks for interchanging business with connections becomes one of first importance, and groups itself with freight storage and handling facilities. These interchange tracks are, under the usual railroad practice, in duplicate, each road furnishing a track on which it receives business delivered to it by the other. Properly located, these interchange tracks should be at the junction of the two lines, and each road should be able to make deliveries without going on each other's main line. The capacity of these interchange tracks to hold cars, the prompt and regular clearing of them, and the keeping of them clear as often as they are filled, is the most essential feature of handling the Terminal Association's business, and 90 per cent. of all delay and congestion experienced by the association within the past three years may be traced to failure at the interchange tracks by one or the other of the parties to the interchange. To facilitate this interchange, the terminal has recently built tracks, conveniently situated, at many points, which, with various arrangements that have been made at other points, will take care of a total of nearly 1,200 cars. This contributes directly to the free interchange of business, and means that where two years ago 1,200 cars were held over for interchange, they can now be delivered at once. This means 1,200 cars at one time, and with proper effort these interchange tracks could be handled two, or even three, times per day.

Having thus cleared the ground, the question of increasing the capacity of the Union Station was next approached. It was obvious from the first that any effort to improve the track plan in front of the station would involve the most radical rearrangement and extremely heavy expenditure. The question was, therefore, approached with the utmost gravity, but operations were demonstrating day by day that even the ordinary business of that period was in excess of the capacity of the track system. This was previous to the World's Fair, and the authorities of the Fair estimated that the atendance would be between 30,000,000 and 35,000,000 people, which, of course, would be largely in addition to the normal travel.

By an examination of the old track layout at the station it will be seen, to begin with, that the express buildings had been brought down to within 75 ft. of the central axis of the train shed, thus constricting the "throat" in such a way that it could not be widened without moving these buildings. Furthermore, there were the strictest limitations to what could be done due to the short distance, 1,103 ft., from the south end of the train shed to the private property of railroad lines to the south, which those lines considered indispensable to the conduct of their own business, and which the Terminal, therefore, could not secure. Further limitations were found on the east in the 18th St. viaduct, and on the west in the 21st St. viaduct, and even if there had been time to negotiate for alterations in these viaducts, which there was not, it was extremely doubtful whether the city would have consented to any alterations. Therefore, all improvement in the track layout had to be made within the area bounded on the south by a line 1,103 ft. from the south end of the old trainshed, on the east by the 18th St. viaduct, and on the west by the 21st St. viaduct. This gave an amount of room entirely insufficient for making an ideal, or even an approximately good, track layout, and the result of all the study that could be brought to bear by those engaged appears in the new track layout, which, while not good, is, it is to be hoped, the best that could be secured within those limitations.

These changes, of course, involved the entire removal of the old interlocking plant (the largest in the world at the time it was built, only 10 years previous), and also the removing of the power house, which had been considered at the time of its erection, 10 years before, to be sufficient for many years to come. The largely increased demands on the power house also made it necessary to almost double the power to be provided. The time in which the work must be accomplished was known to be very short, and was shortened by negotiations with the city, which, although they finally came to nothing, had the result of crowding the work into an almost impracticably short time.

The work was also thrown into the winter months and an illustration will show some of the difficulties encountered. In laying the track south of the train shed during last winter the ground was frozen so that it would have been almost as easy to pick away flint rock as it was to get through the frost. Therefore the simple expedient was adopted of spreading wooden trash and splinters over large areas of ground and burning it the night before, so that by morning the ground would be sufficiently thawed to enable men to pick it. A large proportion of the track in front of the station was laid by this means.

The new Union Switch & Signal Co.'s interlocking plant, the largest in the world, controls 67 double slips, 91 switches and 287 signals from the three towers. The central tower contains a machine of 215 levers, 45 ft. 9 in. long, which is the largest in the world, the next largest being the one at Long Island City of 167 levers. The complexity of the track layout is shown by the fact that there are 1,827 possible routes through this plant, one lever alone controlling 146 movements. The system includes electric annunciators by which the men in the tower are informed whether any tracks under the shed are occupied by any car or engine, and by which the trainmen get a high-speed signal from outlying points, indicating that they may proceed at a high rate of speed to their destination in the train shed, the route being set up and the track clear, as well as electric inter-connection between the towers by which the co-operation of operators in each of two towers is necessary to control signals at the point where the interlocking from the two towers unites.

Among the items especially interesting on account of the novelty of its application, may be mentioned Gray's telautograph, which is used for publishing and recording information sent from tower No. 1 to five points in the station, announcing the arrival and departure of trains. The dispatchers in Tower No. 1 get advice by wire as soon as any incoming train reaches any one of the numerous terminal junction points. That information is immediately published by the telautograph at the station master's office, bureau of information, baggage master's office, baggage handling subway and the south end of the train shed, in order that everybody may be informed that, for example, Burlington train No. 8 was approaching and would arrive on track No. 17, 7:19 a. m. This enables the bureau of information to tell the public when that train will arrive and on what track. It enables the station master to arrange his men to meet it. It enables the baggage master to send his trucks and men to the proper point and makes possible the proper disposition of men and trucks in the subway for handling the baggage, mail and express.

Another interesting departure from ordinary methods is in the application of pneumatic tubes to the baggage service. The vast volume of baggage handled at the station made it impossible to concentrate the work of the checkmen or of the public, some of whom must see the baggage themselves. Under the old method of handling the baggage, the checkman in many cases must take the passenger's ticket and hunt up a trunk in whatever pile it might be located, which might be several hundred feet away, attach check and bring duplicate to the passenger, or the passenger might be required through some lack of identification to pick out the baggage himself. Instead of trying to remedy this, the situation was accepted, and the separation of the checkman from the baggage was made final and complete. The baggage was taken into a subway constructed for the purpose across the south end of the train shed and delivered underneath the track from which it would finally leave, while the checkman was put into communication with an attendant stationed at the baggage, by means of a pneumatic tube which covered the intervening space separating the checkman from the baggage.

Study of the old conditions has also shown the long distance which the baggage had to be transported after it was checked, in order to reach the train. It was received in the old baggage house on 20th St., opposite Walnut St., and had to be trucked on an average nearly 1,200 ft. Not only that, but it had to be trucked across tracks at grade, and as these tracks were often found occupied by long trains or by arriving or departing trains, close connections were continually being missed. Accidents were also common, the baggage trucks being run into by incoming trains. By means of the subway this trucking is cut down to a very small percentage of what it has formerly been, and all danger of collisions averted.

Some details of the manner in which part of the work was carried on may profitably be added to the preceding general description of the improvements. It was directly supervised by Mr. J. L. Armstrong, engineer of maintenance of way, and the portion at the Union Station, where the construction was most troublesome, was under Mr. A. P. Greensfelder, as assistant engineer. The following notes by him are taken from a paper he read before the Engineers' Club of St. Louis:

Various methods were employed for excavating. At the power house, coaling station and engine houses, where the quantities were small, the only feasible method was by hand, casting the earth several times if necessary to load on flat cars placed on adjacent tracks. For the subways, express and mail building adjoining, covering an area of about 5 acres and involving the handling of over 125,000 cu. yd. of earth, the question was a greater one.

Where falsework had been driven over the main subway the headroom was too small for dippers, and the bents would have interfered with steam shovel work, or an orange-peel bucket working from above. Any surface method of excavation would have required the abandonment or use of two or more tracks, or have interfered with the leads into the train shed, which would not be permitted at that time. These reasons, as well as the desirability of keeping construction trains from interfering with passenger traffic, led to the adoption of the method of sub-surface working.

Work was begun from both ends. Excavation was made by pick and shovel, loading into flat cars run in on temporary standard gauge tracks, gradually lowering the cut until, when the exterior lines of falsework were reached, the flat cars could clear the stringers. Headings were then made and the tracks gradually extended through the wide panels, the earth being also loaded from the sides, as the cars were placed. Three tracks were run from the west end and one from the east, and joined near the center. When the earth had been excavated casting distance away from the cars, wheelbarrows were put in service on plank runways nailed to the falsework piles, and often 125 cars a day were loaded in this manner.

Where the subways ran through the old express buildings, advantage was taken of the fact that these buildings rested on piles, to push the excavation under them, by the use of proper bracing. Incandescent lights were strung over the falsework and excavation carried on in ten-hour day and night shifts. The basements of the five express buildings being on the same level as the subway floor, this block was excavated by steam shovel and diggers loading into wagons or cars, and by wheel scrapers. The steam shovel with a one-yard dipper and 100 men, loading into 35 wagons hauling 400 to 500 ft., often excavated in 10 hours over 1,000 cu. yd., of which 45 per cent. was loaded by the steam shovel.

Concrete was the only masonry used in all this work. A mixture of 1 part by volume of Portland cement, 3 parts Mississippi River sand, and 6 parts of St. Louis screened limestone was used on all building foundations and work subject only to stable loading, while a 1:3:5 mixture was adopted to withstand moving engine loads. Concrete was hand mixed in some places, unloading the material from cars directly on to the mixing boards wherever possible, the boards being usually kept near places for deposit of the concrete. Where a machine was used the materials were wheeled from the cars in barrows to an elevated platform, dumped into the machine in the proper proportions, sufficient water added through a faucet in a gauged barrel, the machine turned a few times and then emptied into a trough, feeding the finished concrete by gravity into wheelbarrows below.

A continuous mixer, run by a small steam engine, was placed in a temporary shed at the west end of the main subway and supplied most of the concrete for the long north and south walls. Drop-bottom cars were brought in on an elevated trestle, and the materials emptied into storage bins. The rock and sand were then fed into gauging pans, the cement added, and the whole gradually dumped into the mixer below. Two gauging pans were alternately used to keep the mixer supplied, but constant rate of feed was hard to obtain at all times, and this, together with the difficulty in correspondingly varying the water supply, gave resulting concrete not always of the desired consistency.

On all exterior walls of the subway, a mortar facing, 1½ in. thick on the outside and 1 in. thick on the inside, was built up with the walls to make them waterproof. A 1:3 mortar was made, using washed Meramec River sand free of lignite. The metal plate system was adopted in placing this facing, using 10-in. plates 6 to 8 ft. long. The concrete was placed in 9-in. layers and thoroughly rammed with 12-lb. tampers until water flushed to the surface. This concrete presents a very neat appearance, although the east walls of the express buildings, which were spadefaced, are smooth as well. Work was carried on day and night, as many as 200 men working on concrete at one time on the construction of the subway and express buildings alone.

Gas Producer Regulations have been issued by the National Board of Fire Underwriters. Pressure systems must be located in independent buildings, but suction producers up to 250 horsepower may be placed in a separate, enclosed, well-ventilated room in any building where the natural light is good. While the plant is not in operation the connection between the generator and scrubber must be closed and the connection between the producer and vent pipe opened, so that the products of combustion can be carried into the open air. This must be accomplished by means of a mechanical arrangement which will prevent one operation without the other. If illuminating or other pressure gas is used as an alternative supply the connections must be so arranged as to make the mixing of the two gases or the use of both at the same time impossible. The opening for admitting fuel must be provided with some charging device so that no considerable quantity of air can be admitted while charging.

Legal Complications Over Boiler Design.

The Supreme Court of Errors of Connecticut has recently rendered a decision in Watson v. Bigelow Co., 58 Atl. Rep., 741, which contains so much interesting light on the relations between engineer and supply man that it is here reprinted in full:

The complainant alleges, in substance, that the defendant agreed to make a boiler for the plaintiff for an agreed price, and according to certain plans and drawings furnished by the plaintiff; that the defendant finished the boiler, and delivered it to the plaintiff, who then paid the agreed price; that said boiler was not made according to said plans and drawings, nor in a workmanlike manner; and that, in consequence thereof, it was of no value to the plaintiff. The defenses were, in substance, (1) that the boiler was properly made in accordance with the terms of the contract; (2) that the plaintiff, after examining and testing said boiler, and having full knowledge of all the alleged defects therein, accepted the same in full performance of said contract.

The evidence for the plaintiff tended to show that the defects which rendered the boiler valueless arose from poor workmanship, and a failure to follow the plans and drawings, while that of the defendant in reply tended to show that said defects were due to the fact that the plaintiff's plan of boiler was an unsuitable one for a 60-h.p. boiler, like the one here in question. In rebuttal of this the plaintiff offered certain evidence, to which the defendant objected, but the court admitted it, and the rulings made by the court in so doing are assigned for error. The other errors assigned relate mainly to the charge to the jury.

The rulings upon evidence will be first considered:

The plan of the boiler here in question was invented by the plaintiff, who is a mechanical engineer and machinist, and boilers made according to that plan are known as "Watson water-tube boilers." The boiler in question here was a 60-h.p. boiler of this kind. One of the serious faults found by the plaintiff with the boiler here in question was that its tubes leaked badly when subjected to the ordinary working pressure under which it was designed to be used. The defendant claimed that this leakage was due not to the workmanship of the defendant, but to the plan of construction of the boiler embodied in the plans and drawings furnished by the plaintiff. In support of this claim, the defendant offered evidence tending to show that said plan, as embodied in the boiler here in question, was a vicious one in this respect, among others: That no allowance was made for the difference in expansion and contraction between the steam generating tubes and the outer circulating tubes, and that, as these tubes entered into and were held by the same tube sheets, there was an unequal expansion, which produced the leakage complained of. Prior to the introduction of this evidence, it had appeared in evidence that, before the contract here involved was made, the plaintiff had had made for him, by other manufacturers, some ten or twelve boilers upon the same plan as the one in question here; that, of these, one was a 25-h.p. boiler, others were 10 and 15-h.p. boilers, and two were less than 10 h.p.; and that the one here in question was the only 60-h.p. boiler which had been made upon said plan. As bearing upon the question whether said plan was an unsuitable one for a 60-h.p. boiler, as claimed by the defendant, the plaintiff, in rebuttal, proposed to offer evidence regarding each of said boilers made for him by others, showing the place to which it had been sent, the use to which it had been put, and the fact that he had heard no complaints about any of said boilers. The defendant objected to this line of evidence, and the court allowed an exception to all of it, without requiring the defendant to state specifically the grounds of his objection to each item of it. The court admitted the evidence, and the plaintiff testified at length concerning the facts above mentioned in reference to each of said boilers. We think the court erred in admitting this evidence. The testimony objected to introduced into the case evidence as to many collateral matters which tended to complicate the case, and which the defendant could have been but ill prepared to meet with counter evidence. The defendant was prepared to show that the plaintiff's plan of boiler was an unsuitable one for a 60-h.p. boiler, but by the rebuttal evidence it was, in effect, called upon to show that the plan was an unsuitable one for 10 or 12 much smaller boilers. Then again, if we assume that the rebuttal evidence had any probative force, that force was very slight. In it the fact that no complaint was made to the plaintiff about the small boilers is made the basis of an inference that they all worked well; and this, in turn, is made the basis of an inference that a plan suitable for small boilers was a suitable plan for a boiler more than twice as large. The fact that this evidence, if of any, is of but slight, probative force, and that it complicated the trial of the case by the introduction of many wholly collateral issues, would have justified its exclusion. But waiving the question whether the evidence should have been excluded upon these grounds, we think it was irrelevant and should have been excluded on that ground. The question between the parties was whether the plaintiff's plan of boiler was a suitable one for a 60-h.p. boiler—a boiler more than double the size of any of its kind theretofore made. The defendant had offered evidence tending to show that said plan was not a suitable one for such a boiler. The plaintiff was permitted to meet this by evidence remotely tending to show that it was a suitable plan for very much smaller boilers. If we assume that the plan was a suitable one for these smaller boilers that fact, standing alone, as it did in this case, afforded no legitimate basis for an inference that it was a suitable one for a 60-h.p. boiler. The difference in size between the boilers tested by actual use and the one here in question might well affect the conditions of the test, and there is no evidence in the case to show that it did not. Under these circumstances, we think the court erred in not excluding the evidence.

The defendant also complains of another ruling upon evidence. It had appeared in evidence that the defendant, about the time the boiler in question here was made, had made for the plaintiff a 15-h.p. boiler after the plaintiff's plan. In rebuttal, against the defendant's objection, the plaintiff was permitted to show that said boiler had been improperly made, that the defendant had made a deduction from the price of said boiler on account of said workmanship, and that defendant did not say anything about the plaintiff's plan or boiler, or claim that the defect was due to said plan. This silence of the defendant was offered and received as an admission by conduct on the part of the defendant that the plaintiff's plan of boiler was a suitable one. We think the court erred in admitting this evidence for any such purpose. The plaintiff's claim was that the defect for which he claimed a deduction was due to the defendant's fault. The defendant says nothing, but allows the deduction. Under such circumstances, the fact that the defendant said nothing about the plan of boiler, good or bad, affords no legitimate ground for an inference that it either approved or disapproved of said plan.

On account of the foregoing erroneous rulings upon evidence, we think a new trial should be granted; and, this being so, it will be unnecessary to consider any of the other claims of error, save one. That one relates to the effect of the plaintiff's acceptance of the boiler upon his right thereafter to recover damages for defects in it which were, or ought to have been, known to him when he accepted it. The complaint alleges that the defendant agreed to make and deliver to the plaintiff a boiler of a described kind according to certain plans and drawings, and the only breach alleged is the failure of the defendant to make such a boiler. The evidence for the defendant tended to show that the plaintiff, after an examination and test of the boiler made by himself, and with knowledge that it was not made in accordance with the plans and drawings, had accepted and retained the boiler as his property. In the trial court the defendant claimed that, as matter of law, and irrespective of the question of waiver, such acceptance put an end to the plaintiff's right to recover damages for the defendant's failure to make the boiler according to the terms of the contract; and the defendant asked the trial court to charge the jury to this effect. The trial court did not so charge. On the contrary, the court told the jury, in substance, that unless they found as a fact that the plaintiff, by his conduct in accepting the boiler, had waived his right to recover damages, his right to do so would not be lost merely by accepting and retaining the boiler as his property, with knowledge that it was not made according to the terms of the contract. Whether, in cases like the present, where a thing is to be made according to the terms of a contract, an acceptance of that thing, with full knowledge that it is not so made, puts an end to the acceptor's right to recover damages, is a question upon which the decisions in our courts of last resort are in direct conflict. Some courts hold that, when the thing to be made is finally offered in delivery in performance of the contract, it becomes the duty of the deliveree to examine it, and, if it does not conform to the contract, to reject it within a reasonable time. Failing to do this, he is held, as matter of law, in the absence of fraud or mistake, to have lost his right to recover damages for any defects of which he had, or with reasonable diligence might have had, knowledge. According to this view, the acceptance of the article by the acceptor as his property deprives him of any right to complain of defects in it known to him, or which might have been discovered upon a reasonable inspection. Other courts hold just the opposite to this. According to them, the buyer may accept an article made for him under a contract, although it does not conform to the contract—thus making it his property, and precluding him from afterwards rejecting it—and still retain his right to damages for non-compliance with the contract. According to this view, the seller's engagement to furnish the thing called for by the contract survives the acceptance, and is available to the buyer even after a transfer of title to him. These two views of the law upon this subject are clearly stated in 2 Meechem on Sales, §§ 1392, 1393, and in Burdick on Sales, §§ 220-224, and many cases in support of each view are cited in the notes to those sections by each of these authors. As the court is of opinion that the second of the views above expressed is the one supported by reason and by the weight of authority, we think the trial court did not err in adopting, as it appears to have done, that view of the law. In cases like the present, however, it must be borne in mind that the fact of acceptance may, as matter of evidence, tend to show, with more or less force, according to circumstances, that the article complied with the contract, or that the acceptor had waived his right to recover damages for such non-compliance. The effect of the fact of acceptance, as matter of evidence, in such cases, is clearly and forcibly stated in Moore v. Moore, 83 Me. 473-481, 22 Atl. 362, 13 L. R. A. 224, 23 Am. St. Rep. 783. Ordinarily the question whether the article was accepted as a full performance of the contract, and the question of waiver, are questions to be determined by the jury under the instructions of the court.

For the reasons hereinbefore given, there is error, and a new trial is granted. The other judges concurred.

Electrolysis Investigations in Germany.

The German Society of Gas and Water Engineers, one of the most influential technical organizations of the empire, has a committee specially intrusted with the study of electrolysis of mains by street railway currents. During the past year, according to a review of the committee's report in the "Journal of Gas Lighting," tests and experiments were carried out in Leipzig and Hamburg, where, for the protection of the mains, arrangements had been made which in many respects agree with the recommendations already published by the commission; in Erfurt, where the gas-pipes have been found to be suffering severely; in Freiburg i. B., where no injuries have yet been detected, but where the municipal owners of the gas, water and electricity works desired to have their mains and return conductors examined; in Strasburg, where the water mains have been attacked, and where the local authorities requested an investigation; and in Dresden, where the use of bare return conductors for the electricity offers an opportunity for the collection of unusually valuable information on the whole subject. The most exhaustive researches, however, were instituted in the two last cities.

Measurements of the potential of the mains and tram rails in Strasburg gave figures which were much higher than they should be. Close to the generating station, a mean value of 2.2 volts and a maximum of 2.8 volts were obtained, the mains being positive in respect to the rails. At a great distance from the station, the mean potential was 4 volts and the maximum 11.5 volts, the mains being negative in respect to the rails. Direct measurements of potential at the different points of attachment of the insulated return conductors to the rails were impossible at Strasburg, owing to the insufficient number of test wires. Such wires, indeed, were present, but nearly all were rendered useless through breakage or faults in the insulation. Hence the currents flowing in the return leads were measured, and the resistances calculated from their diameters and lengths. From the resistance and the current, the fall in potential in each cable was calculated; and the differences between the falls in potential of each cable gave the differences of potential between the various taking-off points.

According to the rules of the commission, these differences should be practically zero; at Strasburg they were found to reach 6.5 volts. The return conductors at Strasburg have the same diameters as the outward leads, and are connected to the rails at points exactly opposite those where the outward leads join the trolley wires. (This arrangement is common, because it enables the return to be temporarily made the outward conductor when failures in the insulation occur.) Thus the differences in potential are due to a lack of proper relationship between the volume of current which each return should carry and its length and resistance; and more particularly to the existence of a taking-off point in immediate proximity to the central station, joined to the minus pole of the dynamo through a short thick cable of very low resistance only. When a small resistance piece was inserted in the short return mentioned, the maximum difference in potential between any two different taking-off points fell at once from 6.5 to 2.8 volts; and the corresponding difference between main and rail fell, on an average over the whole district, to about one-half of its former value.

In many places currents up to 1 ampere in volume were found to be flowing in the mains, but only when the cars were running. Given suitable conditions (high current density, a soil capable of acting as an electrolyte), such currents are competent to act very corrosively where they emerge from the pipes. From measurements made simultaneously, it was found that the currents flowing in a few of the return conductors only differed slightly in volume from those in the corresponding outward leads (as should be the case), but that the differences were serious when the conductors were very long or very short. The longest return carried less than a third of the corresponding outward current; the shortest carried more than four times its proper amount. Nothing else can be expected, for as the taking-off point far from the station has a much higher potential than that near the station, much of the current that is supposed to flow back by the long return flows by the earth and the rails, re-entering a return at a point of low potential.

Numerous measurements were made of the conductivity of the rail-joints. This was found to vary very much, increasing the resistance of the entire track even up to 100 per cent. The electrically welded joints, and those made by Goldschmidt's "thermite" process, however, were found excellent, possessing in many cases the same conductivity as the rails themselves.

In many respects circumstances at Dresden resemble those at Strasburg; but as there are two generating stations, and taking-off points exist near each of them, there are two regions or points of minimum potential. Moreover, Dresden is separated by the Elbe into two separate districts, and the two stations are on the same side of the river; so that the stray currents from the one side all pass back to the other through the limited number of mains which cross the bridges. The return conductors, which are not insulated, lie in earthernware channels filled with soil; and as the pipes are not water-tight (many were broken when they were being laid), the earth inside is wet. Thus rails, return leads and earth form three parallel conductors, sharing the current according to their conductivities. In most places the conductors are well joined to the rails every 100 yd. or so; but in spite of the high conductivity of copper, their small diameter enables them to withdraw but little current from the rails, which are jointed excellently. Thus from a point far distant from the station to its vicinity the current carried by the rails steadily increases, large differences in potential occurring in them, as well as in the earth and in the mains.

Measurements made in Dresden show the differences of potential in the rails, per kilometer of track, to increase progressively from 0 to about 5 volts. Some of the mains carry very heavy currents; a large gas main was found to be taking about 4 amperes. The highest differences in potential between mains and rails, where the former were endangered by being electro-positive, were naturally found close to the generating stations, and amounted to about 3 volts. The potentials and currents flowing during the night when the tram service was suspended were negligibly small in comparison with those of the daytime. As at Strasburg, there were no attachments to the return conductors for a proper control of the potentials at the taking-off points.

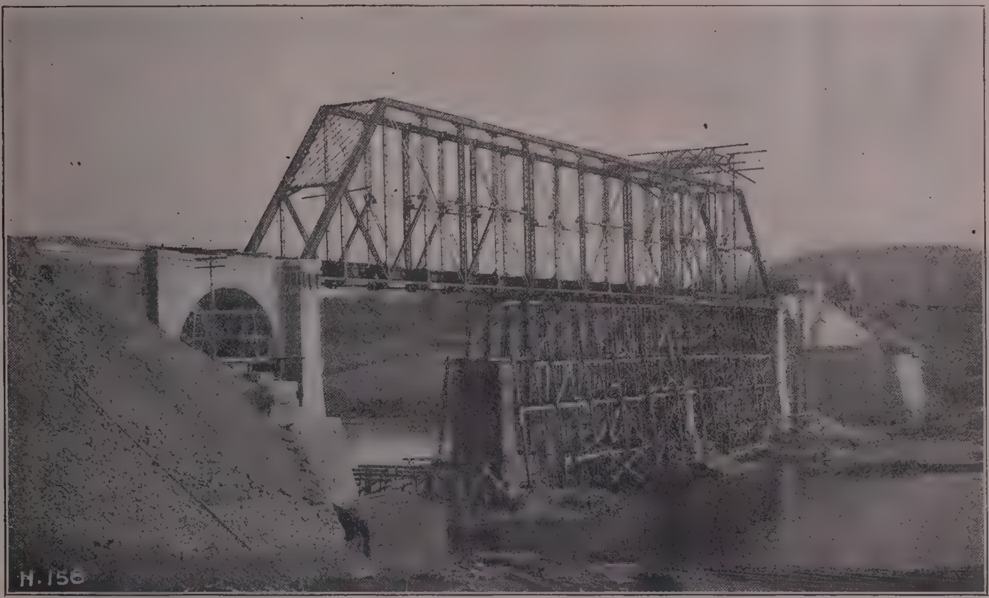
Hitherto noticeable corrosion has only been observed at Dresden in lead service pipes which cross the rails, and then only in the neighborhood of the older generating station built in 1893. These uninsulated lead pipes are good conductors for the stray earth currents, and so to some extent they are reported to protect the iron mains. A trace of attack was seen in an iron pipe laid bare for the purpose of making measurements, and this was also close to the older central station. The condition of affairs at Dresden can only be slightly improved by a regulation of the return conductors. This would ensure a constant potential at all taking-off points; but the escape of current into the earth, and its re-entry into the conductors at suitable spots, can only be avoided by the employment of insulated returns. Some such are now being laid.

The committee was especially asked to examine the case of a 4-in. water main which had been in use for thirty years at Strasburg, and which had got so corroded that a length of 150 yd. had to be renewed. Previous measurements had shown that the pipe lay in a district neutral as regards potential, where neither protection nor corrosion might be expected; and it was therefore thought either that an escape of current from the pipe into the earth (but not into the rails) had been brought about by badly made joints which offered some resistance to the passage of electricity, aided by much ground water and the presence of some other good conductor, or else that the damage might have been done at a former time when electrical conditions might have been different. The joints were found bad in places, and the ground water high; and it was noticed that the pipe lay close to the River Ill, which also flows past the central station. On the other hand, a second main, of equal age, lying in similar soil, in a parallel street, but one in which no tramway ran, was not corroded; and, moreover, the corroded spots in the former were not distributed uniformly round the pipe, but were accumulated at the side facing the rails. Further measurements were made which agreed with the earlier ones; the currents flowing in the mains, and their irregularities due to fluctuations in the working of the tram service, were found to be too small to account for the damage. In the meantime, the old 4-in. main was replaced by one of 6 in., and conditions were somewhat altered.

Inasmuch, however, as this case of corrosion is typical, and it is very important that the matter shall be thoroughly studied, the committee has determined to institute experiments to ascertain whether it is possible for iron to be corroded in a fashion resembling that of the pipe in question when lying in soil of the composition of that in Strasburg, without the assistance of external energy; and, if so, whether the process is accompanied by any local manifestations which can be detected with certainty and measured with fair accuracy. To this end, the committee has sought the aid of a chemist and an electro-chemist, whose researches have already begun.

The Croton Lake Railroad Bridge.

The tracks of the Putnam division of the New York Central & Hudson River R. R. were formerly carried over Croton Lake by a deck bridge with three pin-connected spans 156 ft. 9 in. long, 25 ft. 4 in. deep and 13 ft. apart on centers, which were supported on two masonry piers and two abutments. The recent construction of the new Croton dam will back the water up at the bridge site to a maximum depth of about 40 ft., submerging the old piers. This required considerable changes in the bridge, and it was deemed advisable to replace the three old spans by a new structure having a 384-ft. pin connected through span with trusses 53 ft. 4 in. deep and 21 ft. 4 in. apart on centers. They carry two lines of plate-girder stringers with track 33 ft. above the new water level. They are supported on concrete piers made integral with full-centered concrete arches extending to the old abutments, as shown in the accompanying illustration. These arches have a span of 37 ft. 8 in. between springing lines and are designed to make the appearance of the bridge more effective and pleasing.



New Bridge Replacing Three Old Highway Spans, Croton Valley, N. Y.

The steel superstructure was erected with an ordinary wooden traveler and three-story framed falsework about 90 ft. high from the bottom of the river. The upper stories had two plumb posts and two batter posts in each bent, which were seated on a transverse row of six piles capped about 16 ft. above water level and braced transversely and longitudinally between water level and the tops of the bents. The old span and the traveler track were supported from the falsework caps by solid timber blocking with the upper courses cantilevered a little beyond the second courses to support the top chords of the old trusses, the bottom chords being wedged up from the caps next below the top of the falsework. As the old structure was removed, the members were match-marked for re-erection at other sites.

The new concrete piers were built in open cofferdams and are supported on pile foundations with their tops enclosed by battered concrete footings reinforced at the base by two crossed tiers of grillage rails just above the pile tops. The tops of the piers are also reinforced by horizontal transverse rails bedded in the concrete. The pier masonry and the haunches of the arches are made with 1:3:6 concrete, and the arch ring 3 ft. thick at the crown is made with 1:2:4 concrete reinforced by one sheet of Clinton wire cloth 4 in. from the intrados and another sheet 4 in. from the extrados. The cloth is made with 3x8-in. meshes, using No. 6 wire longitudinally and No. 8 wire transversely. The projecting keys and the faces of the arch ring are coursed to resemble cut stone. At the elevation of the truss seats, the pier is capped with 1:1:2 concrete 2 ft. thick, having 4 in. projection. This coping is reinforced with wire cloth and old rails extending from end to end of the pier. On top of this coping and between the trusses the masonry is built up to form the stringer seat. The upper 2 ft. of this stringer seat is of 1:1:2 concrete reinforced in the same manner as the main coping below. The spandrel walls extend over the pier, forming parapets outside of the truss shoes.

The principal quantities in the structure include about 446 cu. yd. of 1:2:4 concrete, 2,973 cu. yd. of 1:3:6 concrete, 378 cu. yd of 1:4:7½ concrete, and a small quantity of 1:1:2 concrete, all made of Atlas Portland cement. There are 6,560 sq. ft. of wire cloth and 2,584 lin. ft. of white oak piles shod with iron points.

The bridge was designed by the engineering department of the New York Central & Hudson River R. R., Mr. H. Fernstrom, chief engineer, and Mr. Olaf Hoff, engineer of structures at that time. The steelwork was erected by the employes of the railroad company. The sub-structure work was done under contract by the United Engineering & Contracting Co., 21 Park Row, New York.

A Legal Opinion on Pavement.

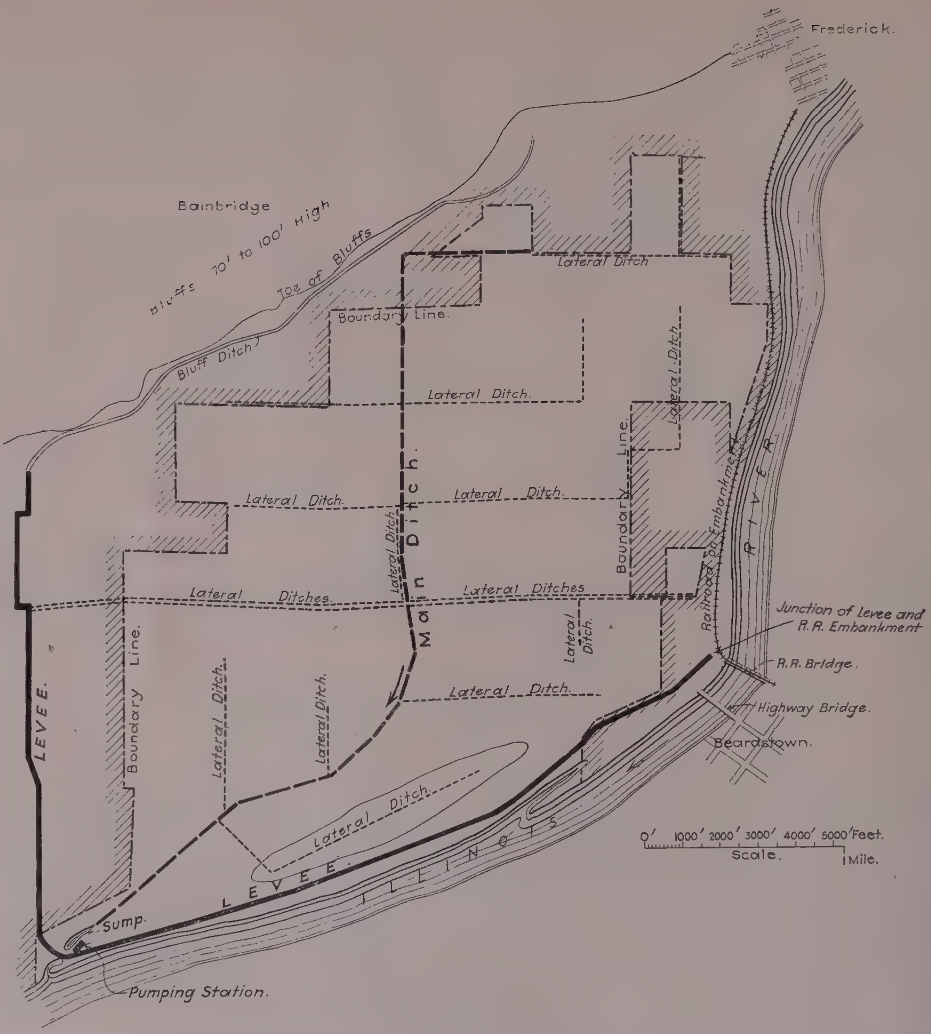
Paving Contracts in Kansas City were recently before the Missouri Supreme Court for interpretation, 83 S. W. Rep. 1062, and it was then decided that a provision requiring the contractor to keep an asphalt pavement in repair for five years was not void on the ground that the city charter does not permit charging abutting property for repairs. It was also decided that where a street improvement is contracted for as a whole, the fact that, owing to the presence of street car tracks, only half as much paving was laid by the contractor in front of certain property as was laid in front of property on another part of the street, did not render invalid the apportionment of the cost of the entire improvement according to the front-foot rule. Where a street improvement ordinance and contract required the work to be commenced at a certain time and completed within 60 days, the fact that the contract provided that no work should be done on any day when the temperature was below 35° and that there were not 60 days between the time for commencement and the time for completion when the temperature was above 35°, does not excuse, the court rules, the contractor's failure to complete the work in the time fixed.

The Testing Station of the British Fire Prevention Committee has recently been moved to a new site, where a number of new test huts have been erected. The fuel generally used will be gas supplied by a Mason producer, and will enter the main room of each hut from a mixing chamber. For temperature measurements Roberts-Austen recording pyrometers are employed. The station is near Charing Cross, to enable London committeemen to supervise tests readily.

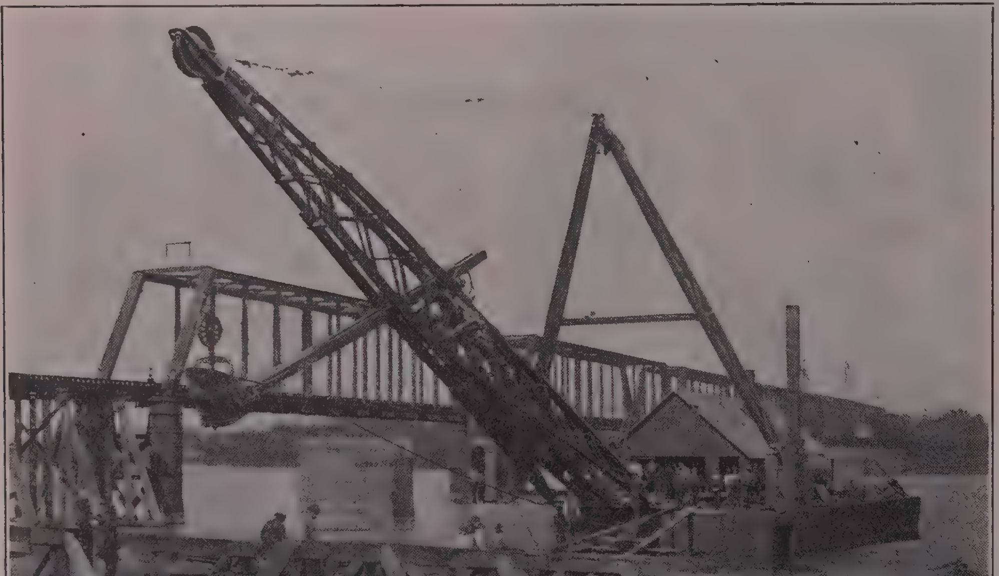
Land Reclamation Along the Illinois River.

The reclamation of large tracts of land, several feet below high water, on both banks of the Illinois River has been undertaken recently, and the flood protection of ten tracts, varying from 3,000 to 15,000 acres each and aggregating nearly 80,000 acres, will be completed in the next year and a half. The difference between high and low-water levels is about 15 ft., and during even ordinary floods immense areas of low land in the river bottom are completely submerged, the river frequently being several miles wide. This low land is unusually fertile, but as it is overflowed on an average three times in five years and the floods occur during the growing season it cannot be cultivated with any degree of safety unless protected by levees. The protection afforded by the levees also has to be supplemented by pumping plants, which elevate the drainage from the protected area and discharge it into the river, which is often higher than the bordering land for considerable periods.

The Coal Creek Drainage and Levee District, one of the first tracts to be reclaimed, comprises 7,000 acres along the west bank of the Illinois River, opposite Beardstown, Ill. This district was formed under the laws of the State of Illinois, and all land in it was assessed according to the benefits expected to be incurred by the proposed improvement. Its affairs are managed by a commissioner elected by the land owners, the cost of the construction of the protecting works being levied pro rata on the lands within it, and the maintenance expenses are raised in a similar manner.



Map of the Coal Creek Drainage and Levee District.



Dredge Used in Building Levees and Digging Drainage Ditches.

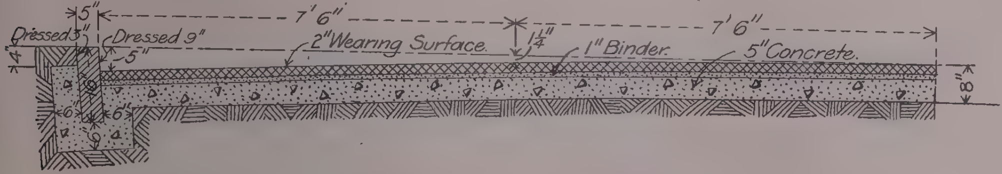
The land in the district is typical of most of that which is being reclaimed. Much of it was formerly covered by heavy growths of swamp grass and in some places by heavy timber, practically none of it being cultivated. The Chicago Burlington & Quincy R. R. crosses the river a short distance above the middle of the river side of the district and then parallels the river for three miles on an embankment which at its lowest point is 3 ft. above highest flood level. This embankment was constructed of material from borrow pits on the river side and is maintained in good condition, forming an excellent levee which joins the high land at its upper end. A levee was built from the point near the end of the river bridge where the railroad embankment begins down the river for 4 miles, closely paralleling the water's edge. At the lower end of this river levee a similar one was built at nearly right angles to it and extending inland for 2.75 miles to the foot of a high bluff which bounds the district on the land side.

The new levees were constructed by a boom and bucket dredge with material borrowed on the river side of the site. They were built to a height of 3 ft. above high water and have a minimum width of 3 ft. on top, with slopes of 3 in 1 on the river side and 2 in 1 on the land side. All vegetation and underbrush on the site of the levee were removed and the surface plowed in advance of the work. In timber land all trees were cut down and the stumps pulled or blown out, the roots being removed to a depth of 3 ft. The dredge bucket had a capacity of 2½ cu. yd. and was operated on an 85-ft. boom supported at the base on the hull of the dredge and attached at the opposite end to a pair of A-frame derrick legs mounted near the middle of the hull. It was built across the river from the upper end of the levee on the river bank and when completed was towed to place and moved ahead as the excavation advanced, building the embankment to within about 6 ft. of the finished grade. The remainder of the embankment was completed by the dredge on a second round. It was impossible to build the embankment to the full height on the first round because the material was so wet that it would continue to spread beyond the limits of the levee if the full amount of it was placed at one time.

The levees built in this manner have been subjected to several floods which they have withstood safely, and the seepage through them when the river is in flood is not sufficient to interfere in any way with the cultivation of the protected land. Although constructed largely of alluvial soil from the river bottoms they have required little maintenance as the stream velocity does not exceed 2.25 miles an hour, so practically the only repairs have been some regrading of the slopes on the river side. About 600,000 cu. yd. of material was handled on the construction of the levees, which average about 15 ft. in height.

A ditch about 40 ft. wide and 7 ft. deep was dug parallel to the base of the bluffs on the land side of the district to intercept the drainage from the land above it. This ditch passes through the levee near the point where it joins the foot of the bluffs and discharges into the river through the borrow pit formed during construction. The outlet from it is controlled by sluice gates in the levee. A small creek which frequently overflowed formerly extended diagonally across the district from the inland upper corner to the lower corner nearest the river. This creek was dredged to a depth of 7 ft. and a width of 30 ft., and a system of lateral ditches dug in connection with it, forming a drainage system which intercepts and carries to the lower river corner of the district all the surface water. At the lower end of the main ditch a large sump was excavated and a brick pumping station erected beside it.

The station building contains a 24-in. and two 15-in. centrifugal pumps built by the Morris Machine Works, Baldwinsville, N. Y. They are driven by 14x36-in. 150-hp Corliss engines made by the Murray Iron Works, Burlington, Ia., and have a combined capacity of about 35,000 gal. per minute, operating with an average suction lift of 12 ft. and against a head depending on the stage of water in the river. They discharge into the river through a 26-in. and two 20-in. cast-iron pipes, which are laid through the bottom of the levee and are fitted with check valves on their discharge ends. The pumps are operated on an average about 90 days in the year, and during that time the periods are short when the flow to be handled is large, the plant taking care chiefly of the storm-water drainage when the water in the river is at or above the level of the land. The average rainfall is nearly 40 in., much of which comes in the spring, and during practically three-quarters of the year the surface drainage flows into the river by gravity through openings in the levee controlled by sluice gates near the pump house.



Half Standard Cross-Section of 30-ft. Asphalt Pavement on Concrete Base.

The flow from the Chicago Drainage Canal has an imperceptible effect during floods, according to Mr. F. J. Traut, commissioner of the Coal Creek Drainage and Levee District, on the stage of water, as the river is then often several miles wide in many places. The flow of the canal, however, has had a marked effect on the character of the stream, and he says that the low water stage is about 2 ft. higher than it was before the canal was opened. The river was previously extremely sluggish during most of the summer and its surface was covered in many places by a greenish-yellow scum. The canal, however, gives a permanent head in even the driest seasons, which is sufficient to impart a cleaner and fresher appearance to the water and to avoid the accumulation of scum.

The formation of this and other drainage districts is resulting in the reclamation of land which was formerly practically uncultivated, although when cultivated under favorable circumstances it yields immense crops, principally of corn. The 125 square miles that are reclaimed or being reclaimed form only a part of the large amount of rich land that is periodically overflowed and rendered waste. The same methods are being employed in the protection of the other districts formed under the drainage laws of the state that were followed in this one, although some of them do not have pumping plants.

The construction of the levees and the excavation of the drainage ditches was carried on by Messrs. Christie & Lowe, of Chicago, Ill. The work was supervised by Mr. F. J. Traut, of Beardstown, Ill., and as commissioner of the district he has charge of the maintenance of the levees and the operation of the pumping station. Messrs. Christie & Lowe own about 4,800 acres of the land in the district and the remaining 3,000 acres are owned by small farmers.

Some Unusual Experience with Asphalt Pavements.

Clinton St., in Brooklyn, N. Y., is practically the only street paved with asphalt that connects the terminal of the Brooklyn Bridge and the park and boulevard system of the borough. The pavement was laid over old pavements and owing to the instability of the original pavements the street surface has been maintained with increasing difficulty. The old pavements are being entirely removed and a standard sheet asphalt pavement with a concrete base laid to replace them. The street was first graded and paved with cobble stones in 1836, and it was not repaved until 1869, when the original pavement was removed and a Nicholson wood-block pavement laid. This wood-block pavement consisted of untreated pine blocks, 3x12-in. in cross-section and 6-in. high, laid on a floor of 1½x12-in. by 15-ft. pine plank. The planks were laid longitudinally on a layer of fine gravel about 2-in. thick, with transverse planks as sleepers on about 10 ft. centers. The pine blocks were set on edge, with the grain of the wood vertical, and in transverse rows with ¾x3-in. wooden strips between the transverse joints. The remainder of the joints above the strips was filled with coal tar and ¼ to ½-in. gravel.

After the wood-block pavement had been in use for several years it was covered with a layer of coal tar and gravel laid according to the Scrimshaw patents. This pavement consisted of ordinary coal tar and fine gravel and varied in thickness from 2 to 4 in., depending on the amount the surface of the wood-block pavement had become worn. In 1888 a sheet asphalt pavement was laid over the coal tar and gravel, making three distinct pavements in successive layers on the same street. The surface of the asphalt had become badly filled with depressions due to the settling of the old pavements beneath it and it was difficult to maintain even at an excessive cost, so the repaving of the street has been undertaken.

The sub-surface structures which were not permanently located were first relaid before any of the old pavement was torn up. The curbs on both sides of the street were then carefully reset with new bluestone, according to the standard specifications of the Bureau of Highways, Department of Public Works, of Brooklyn, for stone curbs set in concrete for asphalt pavement on a concrete base. These specifications require the stones to be of the best Medina sandstone, North River bluestone or granite of the quality specified for paving blocks, provided that only one kind of stone shall be used in the same contract, except on long contracts, when the engineer can allow different stone on different blocks. The stones must be 16 in. deep, not less than 3½ ft. long, nor less than 5 in. in thickness, except the bottom of the stone, which is roughly squared to a width of not less than 3 in. The face for a depth of 9 in. is dressed to a surface which is out of wind and has no depression measuring more than ¼ in. from a line or straight edge the same length as the curbstone. The top is beveled ½ in. in 5 in. of width and dressed the same as the upper part of the face. The lower part of the face is required to be free from projections of more than ½ in. and the back for 3 in. down from the top is not permitted to have projections greater than ¼ in. measured from a plane at right angle to the top. The ends are squarely jointed, with no depression greater than ⅜ in., measured from a straight edge, for the width of the stone for a distance of 4 in. down from the top, and below that to 12 in. below the top of the curb, for 1½ in. back from the face.

The general arrangement of the curb on its concrete foundation and of the asphalt and the concrete base under it of the Clinton St. pavement is the same as is required by the standard specifications of the Bureau, and is shown in an accompanying illustration. The concrete foundation for the curbstone is required to be not less than 6 in. thick and 17 in. wide and the concrete base under the asphalt must be at least 5 in. thick. The concrete is mixed in the proportions of 1 of Portland cement, 3 of sand and 6 of broken stone, the unit of measure being a barrel of packed cement. The broken stone may be trap, granite, limestone or other approved stone, but it must be entirely free from dirt and in the pavement base of graded sizes such that all will pass through a revolving circular screen having 2½-in. holes and be retained by a screen having ½-in holes. The stone in the concrete for the curb foundation has ¼ in. as the minimum and 1½ in. as maximum dimensions.

The old pavements are torn up as soon as the sub-surface structures have all been permanently located. The wood in the old block pavements after having been in place for 36 years is found to be in a very good state of preservation, although there are evidences of dry rot in places, principally in the planks, and the tops of some of the blocks are badly broomed. The tar in the Scrimshaw pavement does not appear to have deteriorated to any appreciable extent and the pavement is still pliable enough to be bent easily, but it can at the same time be broken in the fingers.

The concrete base is laid as fast as the old pavements are removed and the sub-grade given the proper crown. The concrete is being mixed by hand on this work, although machine mixers are used on much of the highway work in Brooklyn. The sand and cement are mixed dry, then made into mortar by the addition of water, when the broken stone is added and the whole mass thoroughly mixed. The concrete is spread on the sub-grade and rammed so as to fill the voids of the stone with mortar and bring the surface exactly 3 in. below the finished pavement, the asphalt making up the remainder.

The asphalt pavement is the standard of the Bureau of Highways of Brooklyn and consists of a 1-in. binder course laid directly on the concrete base and over it a 2-in. wearing surface.

The repaving is being carried on as regular maintenance work by the Bureau of Highways, Department of Public Works of Brooklyn, Mr. Geo. W. Tillson, chief engineer; Mr. C. D. Pollock, assistant engineer, is in immediate charge of the work, and it is being executed by the Barber Asphalt Paving Co., of New York.

The Erection of the James River Viaduct, Richmond, Va.

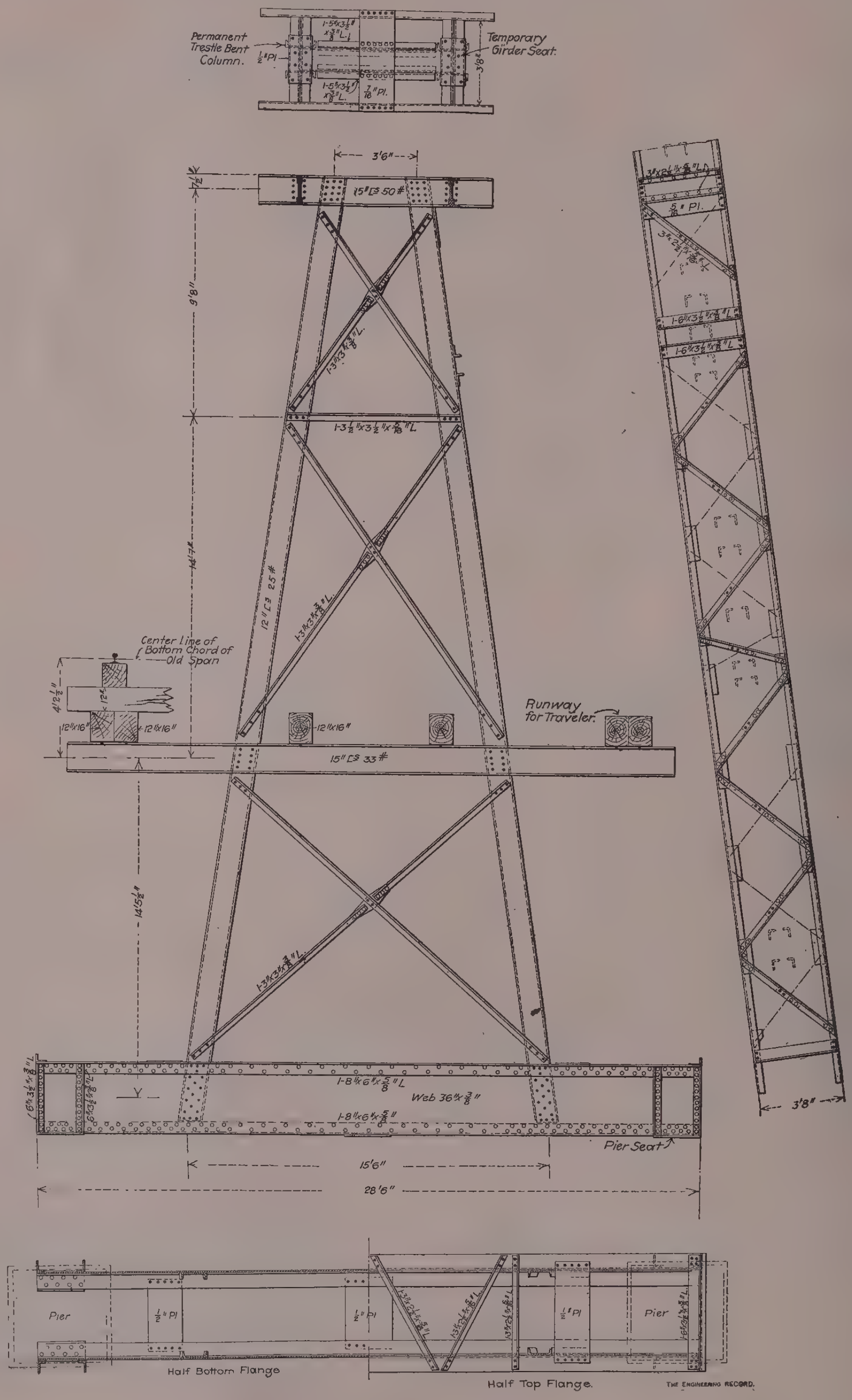
The original Atlantic Coast Line R. R. bridge across the James River at Richmond, Va., was a single-track structure about 1,825 ft. long and 60 ft. high above the water, which consisted of light pin-connected truss spans about 150 ft. long, with stone masonry piers. The increasing weight, frequency and speed of the trains were more than it was calculated to support, and, as both superstructure and substructure began to be seriously impaired, it was decided to replace them by a completely new structure with the same level and alignment. It was found more economical to change the design and make the new structure with alternating 30 ft. and 47 ft. plate girder spans supported on steel towers each of which is seated on four slender concrete piers about 15 ft. high above low water, and has a granite cap and a footing carried down to solid rock a short distance below low water level.

There are 23 spans of 29 ft. 9½ in., one span of 30 ft. 8¼ in., 23 spans of 46 ft. 9 in., and one span of 47 ft. 10½ in. The girders are all 6½ ft. apart on centers and 58 in. deep, and are of the simplest construction, with ⅜-in. web plates and 6x6-in. flange angles, reinforced for the long spans only with two 14-in. cover plates. They are connected by transverse sway brace frames, and by top and bottom zig-zag angles. The bearings are on the ends of the lower flange angles, without sole plates, and they are secured by four bolts in each end through the cap plate of the tower column. In both ends of the short, or tower girders, these bolts have round holes for fixed end connections; in both ends of the long girders they have slotted holes to provide for expansion and contraction. The columns are made in single lengths, from pairs of 15-in. channels, latticed, and have riveted horizontal and diagonal struts in the longitudinal and transverse faces, making alternate towers and open panels. The long and short girders weigh about 13,500 lb. and 6,000 lb. each, respectively.

It was necessary to maintain traffic while reconstructing the bridge, and the new piers were made to carry the old structure during its removal, the new structure during its erection and afterwards, and the traffic and the erection traveler. This was ingeniously accomplished by putting pairs of temporary transverse girders across from pier to pier and supporting from them steel transverse falsework bents clearing the permanent bents. These bents carried the traveler, the old trusses and the new girders and track, and provided for the erection of the permanent transverse bents after the removal of the old trusses which at first prevented their erection.

The inclined posts in the falsework bents were each made of a pair of channels spaced very wide apart and latticed together with panels arranged to clear the posts and struts of the permanent new bents which intersect them. The batter of the posts was less than that of the permanent posts and the width of the bent being correspondingly smaller, their lower ends were supported between the piers by a pair of transverse plate girders, each made with a single outside flange angle top and bottom, and clearing the pier seats for the new posts. The upper ends of the posts supported a rectangular horizontal framework of channels and girders with seats for the new main girders. The webs of the post channels were connected to the transverse channels whch cantilevered beyond them and were connected on each side by short longitudinal girders with top flange plates to receive the ends of the new main longitudinal girders in their required positions.

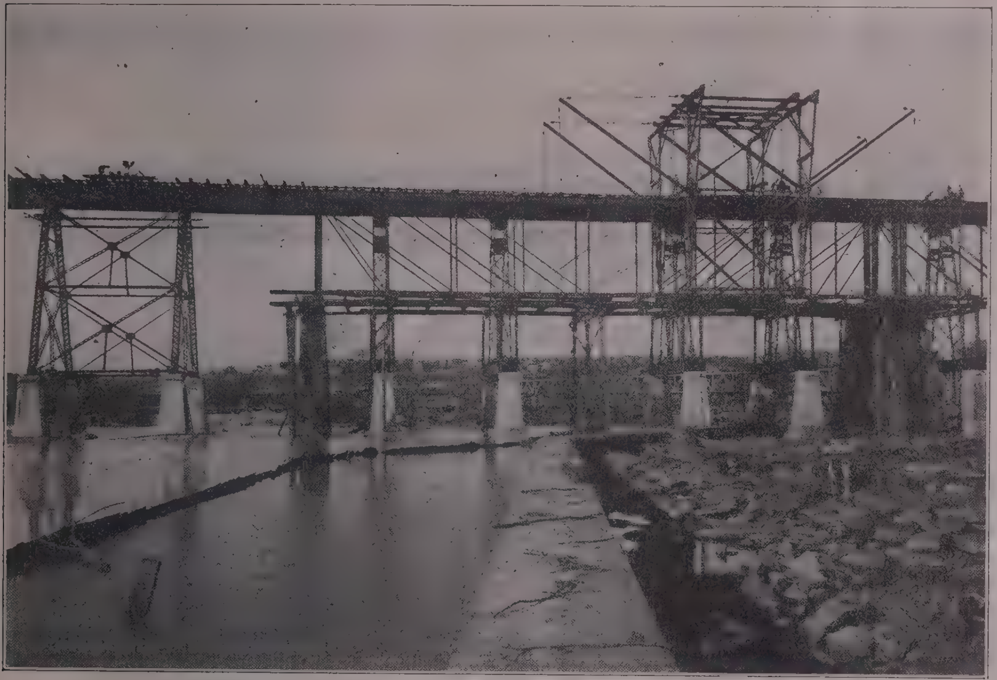
At the commencement of operations a short section of traveler track was built at one end of the bridge, with one rail 11 ft. each side of the bridge axis, clearing the old structure at lower chord level, about 28 ft. below the base of track rail. On this track an ordinary wooden strident two-bent, tower traveler was assembled with horizontal and vertical clearance for both bridge and trains. Each of the four vertical posts of this traveler was provided with a 45-ft. 8-ton boom seated about 30 ft. above the traveler sill. With these booms the steel falsework bents were erected on the new piers and midway between the towers single transverse wooden falsework bents high enough to reach to the old lower chords were erected. These steel and wooden bents carried the traveler track and the old trusses, and were erected for one span which was replaced and then they were transferred to the next span and so on. The members of the steel bents were all received separately and assembled with ⅞-in. bolts in reamed holes, no rivets being used. The members were thus easily inserted between the old truss members, allowed the new tower members to be assembled through them and were afterwards easily removed without interfering with the latter. The old track ties were seated directly on the top chords, 8 in. apart. They were removed and new ties and the plate girders put in on the falsework bents, between trains, in minimum intervals of 50 minutes. To facilitate this operation the grade was temporarily raised 2 in. After the traffic was thus transferred to the new girders the old trusses were blocked up on the two lines of 12x16-in. stringers, 6 ft. apart, carried by the cross beams of the steel bents, and the trusses were disconnected and removed by the traveler booms. The short longitudinal girders connecting the cantilever ends of the transverse bent caps and receiving the girders were then unbolted and removed, leaving the girders supported temporarily a few inches from the ends on the top flanges of the cantilever beams.



Steel Falsework Bent Supporting New Girders and Traveler Track.

The new tower posts were inserted between the cantilevers, their tops occupying the positions formerly filled by the short longitudinal girders and receiving the ends of the new main girders. The horizontal and diagonal struts were riveted to the posts completing the towers, the members of the falsework bents were unbolted and removed, and the same operations were repeated for the next span. All material was brought in and out between trains on the main track, the new girders were unloaded from the cars by double pairs of tackles suspended in the usual way from jigger beams in the top of the traveler and were fleeted directly to place so as not to require rehandling. These tackles and those for the boom hoists and topping were operated by 6-spool Lidgerwood engines permanently located on one shore. Field rivets were driven by hand. The total weight of the new superstructure and towers is about 1,929,992 lb. and it was erected by an average force of 30 men in about 121 working days.

The bridge was designed and constructed under the direction of the engineering department of the Atlantic Coast Line R. R., Mr. E. B. Pleasants chief engineer. The shop plans were made and the superstructure was built and erected by the Phoenix Bridge Co., Mr. John Sterling Deans chief engineer and Mr. C. B. Milliken superintendent of erection.



Steel Falsework and Traveler for Rebuilding James River Viaduct.

A New Type of Roof has been adopted for a paint shop of the Public Service Corporation of New Jersey at Newark. The saw-tooth type delivering a north light is winning favor, yet it has disadvantages. The gutter connection is not easily made, the gutter is kept tight only with some difficulty, and in winter snow banks up on the glass so as to obstruct the light. In the Newark shop, the columns carry an ordinary Fink roof truss of 44 ft. span. At the ridge the southern slope of 2-in. spruce is not stopped, but is continued until it is over the center of the northern half of the roof truss. At this point a vertical drop is made to the top chord of the truss, and in this vertical drop is placed the glazing. The lower half of the northern part of the roof, resting on the truss in the standard manner, is of 2-in. spruce. This construction has all the advantages of the usual pitched roof and also the merit of affording good overhead illumination.

The Principles Governing the Valuation for Rate Fixing Purposes of Water Works Under Private Ownership.

A paper read before the Pacific Coast Engineering Congress by Arthur L. Adams, M. Am. Soc. C. E.

Purpose and Scope of Paper.—The constantly increasing interest among the thinking people of this country in the evolution of some process by which so-called "public service corporations" may be brought under such government control of rates charged by them as will secure protection to the public against unfair discrimination, insures the making of no greater average charges for the service rendered than such service is reasonably worth, and at the same time will afford such properties immunity from spoliation under the guise of lawful regulation, is justification for the careful consideration of any important aspect of this very important subject. That many of the problems involved are of a character calling for solution by those familiar with works construction and management, and that the aid of such men is frequently sought to assist the courts in reaching right conclusions in cases arising under existing laws, fully warrants, in the opinion of the writer, this presentation. Legislation on the subject may as yet be regarded as in an experimental stage; and the resulting accumulation of experience has demonstrated th unwisdom of many of the methods employed in attempts to establish such control. The whole subject needs most careful consideration by those whose training best fits them to devise methods with a clear vision as to their practical consequences.

The regulation of rates by governmental agency, whether such regulation takes the form of the fixing of rates outright or the revision of rates made by the corporation, presupposes the right of the corporation to receive a fair and just return upon the value of its property. The ascertainment of what constitutes the fair and equitable value of such properties is always the important initial step. It gives rise to most interesting and complex questions involving the consideration of ways, means and cost of construction, of the subsequent practical conduct of such works as to their operation, maintenance, growth and financial management, and the value to the public of the service rendered. It also calls for the exercise of the judicial temper, a keen sense of justice and fair dealing, and often no small measure of imperviousness to public criticism. The first before mentioned requirements are certainly such as must be possessed by any successful engineer of high professional standing; and impartiality, discriminating judgment, and equanimity under trying conditions should certainly characterize the members of a profession so often called upon to decide between contending interests. It is, therefore, the writer's belief that our profession will fail of its privileges and its duty if it does not influence in a very large degree the final formulation of wise legislation on this subject, and sound court interpretations.

The principles governing the determination of value of all such properties are quite similar; and though this paper deals with but one class, as its title indicates, the writer hopes it may prove of interest to specialists in other lines. No effort will be made to treat the subject of appraisement even of water works in all its aspects, but rather to assume conditions likely to prevail in bringing most public service corporations under governmental control or supervision as to rates.

By the adoption of certain premises it is intended that all exceptional cases arising from special contracts, special legislation or otherwise, shall be turned aside and the question become a general one as to what under the more ordinary circumstances constitutes the just and reasonable value of water works properties of private corporations devoted to and being used for the public convenience. And even when thus restricted the limitations of space will limit the writer to the discussion of the leading principles and factors only.

It is therefore presupposed:

First: That works are built under legal authority imposing no restraints affecting their value.

Second: That the value of the property is sought as the basis for the fixing of such rates by governmental authority as shall return the owners a fair and just compensation for the service which is rendered.

Fundamental Factors Influencing Value.—The question of what constitutes reasonable and just value under the above conditions ordinarily necessitates the consideration of the following questions:

(1) Is the plant of such a character as to enable it to properly fulfill the obligations which it has assumed of supplying the public with a suitable water service, both present and future?

(2) What has been the cost of the works?

(3) Has its acquisition been characterized by the exercise of a reasonable degree of prudence and engineering skill?

(4) Has the policy of the rate-fixing authorities been such as to make necessary any special financial policy in the conduct or acquisition of the water works properties, with special reference:

First: To the refunding of capital invested in structures of perishable character, or having a usefulness limited as to time.

Second: To the allowing of interest returns upon properties acquired for future use of an increasing population.

(5) Would a reduplication of the existing structural works cost less or more than the present structural works have cost?

(6) Would the construction of substitutional works cost less or more than the present works have cost?

(7) Have the real estate and water producing properties of the company increased in value?

(8) Has the franchise any value?

(9) Does any special value attach to the fact that the company has an established business capable of producing an adequate revenue?

(10) Does the value of the service rendered to the consumers limit the value of the property?

No single formula can be made sufficient for the determination of value in all cases. Each of the above enumerated factors and possibly others may, under certain circumstances, properly exercise an influence in determining the final result. The degree of weight which attaches to each may vary greatly with circumstances. No final conclusion can be intelligently reached until all have been considered and their relative importance weighed, often one against the other.

Value is, therefore, not a quantity which can be determined with any mathematical accuracy. Its limitations as to maximum and minimum can usually be fairly well defined. When circumstances require the naming of a specific figure it can only be reached by the final, possibly arbitrary, exercise of personal discretion after reasoning processes have so far as possible narrowed the field of its final employment.

The application of the result, however, in determining rates is of itself subject to no absolutely defined rule and admits of a considerable range of use without doing violence to natural standards of fairness and equity. That value, therefore, cannot be determined with mathematical nicety, does not detract from the usefulness of a conclusion, though it be in a sense approximate only.

The before enumerated fundamental queries will now be taken up in their order for the purpose of showing their relation to reasonable value and to some extent the manner of their application. These factors are so closely inter-related that it requires careful analysis to make clear their bearings the one toward the other and the limitations which each imposes upon the result sought.

The Fitness of the Plant to Fulfill the Obligation which the Company has Assumed of Supplying the Public with a Suitable Water Service, both Present and Future.—The relations between the public and the water company are of a mutual character. If the public owe the company a sufficient revenue to operate and maintain its plant and to pay its owners a reasonable return upon its value, no less does the company owe to the public an abundant and uninterrupted supply of good, potable water. It owes the exercise of such energy, prudence, skill, economy and capital as will successfully anticipate contingencies of accident or increased demand, and such as will at all times enable it to supply water at the least cost to the consumer consistent with justice to its stockholders.

Fair treatment and a fair valuation on one side presupposes the maintenance of an efficient and economical service on the other, and the vice versa is equally true. It is, therefore, proper that inquiry be made into the character of the plant used and intended for supplying water. Such an inquiry, particularly in regions of lesser rainfall, naturally fall into the following order:

(1) The water supply as already developed as to quality and quantity.

(2) The adequacy and suitability of the provision for future increase.

(3) The present consumption and possible future demand.

(4) The suitability of the works for conveyance and distribution.

The scope and character of the investigations necessary to develop the desired information embraced under these various heads will, of course, differ greatly in different cases. With but one exception they call for no comment here. The appropriateness of each subject in determining value would seem to be beyond question. The second has, however, been called in question and claims attention. It has been contended often, and even so held by certain courts, that in determining value only properties actually employed for the delivery of water or maintenance of the service at the time in question should be included. In view of this sentiment it is well, therefore, to remember that the duty of a water company to maintain an efficient service implies and imposes the responsibility for anticipating the future increase of consumption, that the available supply may never for one moment fall below the proper and legitimate demand.

This responsibility in the supplying of a city means the forecasting, often for many years, of the probable population and per capita consumption.

It often means the necessity for the acquisition of necessary lands, water rights, and storage reservoirs years in advance of their actual use for the delivery of water, lest when imperatively needed they be impossible of acquirement or are purchasable only at a prohibitive price.

The building of structures of the magnitude often required is in itself not infrequently a work of several years.

It therefore follows that at all times the water company must know in advance just where and in what quantities its future water supplies are to be secured.

The relation of such acquisition to present value will more appropriately be taken up under a later head.

The Cost of the Works and Its Relation to Value.—Cost alone is seldom determinative of the value of any enterprise. Such value may be very materially influenced by the worth of the business, that is the amount of its earning capacity, present and prospective; or by the probable cost of building a new plant of equal or better efficiency, or by other considerations.

But in the case of a system of water works devoted to public use at a rate of compensation fixed, not by its owners, but by governmental agency and so fixed as to yield as a net return a moderate rate of interest only on the value of the property employed, the reasonable actual cost of such properties to their owners would seem to represent in almost all cases the lowest value upon which a rate schedule can with any claim to equity be based; and though said cost may be by no means determinative of full value, it may be regarded as the most important factor involved and the one usually determinative of the minimum of value.

Reasons for this view are simple, direct and conclusive, because founded on the practical necessities of water works construction, operation and financial management. They may be enumerated as follows:

First: The purveying of water in a modern city is a necessity, upon which the welfare and very existence of the community depends. This service must, therefore, for the public good be performed by either private or public initiative regardless of how great may be the necessary cost.

Second: When rates are so fixed as to cover only the expense of maintaining the plant in a serviceable condition and pay a current rate of interest on the value of the property, such a policy precludes the company's making any financial provision for safeguarding its investments against depreciation by subsequent reductions in the market price of materials and labor, or otherwise.

Third: Water works properties of magnitude are never created at one time. They are the product of years of growth, being increased and extended a little at a time from year to year in compliance with the demands of the community growth. In many western states water service must largely precede instead of follow population, while the supply must always be maintained in quantity well in advance of present demand.

Fourth: The imagining of a system created as of one time at current prices of lands, materials and labor is wholly fanciful and has never supplied a large city with water, though such an assumption, as we shall see, at times has its use.

Fifth: The final test of accuracy in every estimate is the actual cost of the completed work, built as such works are of necessity actually built. Actual cost of the completed works must, therefore, be entitled to far greater weight in determining their value than any mere estimate resulting from the unavoidable assumption of impossible or unnatural conditions, and the use of assumptions in lieu of the results of accomplished fact.

Sixth: Materials and labor once purchased and used as a part of a system of water works are no longer commodities in the market with value fixed by the rise and fall in prices of new materials and labor. At a certain cost these things have already entered into the creation of a system and are devoted to a fixed and permanent use; and why should one adopt as a starting point in the determination of structural values a standard subject to daily and almost unaccountable market variations in preference to a standard that actual accomplishment has unalterably fixed? There appears no good reason for so doing so long as the statements of actual cost are worthy of credence and their reasonableness unimpeached.

If, on the other hand, the rate fixing powers have made such liberal provision in the revenue as to permit, in addition to adequate returns upon the property value, the making of ample provision for safeguarding the property against loss through falling prices of materials and labor, or the deterioration of perishable materials, or the abandonments incident to changing conditions, as well as other possible causes of loss, then cost becomes of lesser importance in determining a just value of all structural works, and corresponding greater weight may attach to estimated cost of works of duplication or substitutional equivalent without working injustice.

In determining the actual cost to a company of its plant recourse can usually be had to its book record. The reliability of such record can, by a competent engineer, generally be determined by a study of the property. Not with exactness, of course, but within such reasonable limits as is worth while attempting in arriving at a final determination of present value, involving, as it does, so many broad considerations.

An important question, however, relates to the disposition of losses early in the history of the plant arising from a lack of revenue, and their relation to cost and value.

The correctness of the policy of adding annual deficiencies in the operating of a plant to investment in determining the cost of a property to its stockholders as contrasted with other forms of investment paying current rates of interest is, of course, admissible. That such a course throws any light upon the question of value of the property is not so clear and needs amplification.

In ordinary competitive enterprises such a computation would indicate nothing more than the loss which had been sustained in comparison with more remunerative forms of investment. If, however, as in the case of almost all water works, the enterprise be of a character which does not usually and therefore is not expected to yield adequate returns for some years after its inception, making the anticipation of this condition necessary to the successful financing of the enterprise and its establishment on a firm basis, such early losses may be charged to investment and became a measure of the money value of that intangible, though none the less real, asset known as "established business" or quality of being a "going concern," or possessing the ability to earn an adequate revenue, which the courts have recognized in certain important cases.

With a meritorious enterprise there should, of course, come a time in a reasonable period when the earnings become sufficient to pay a proper return upon the investment, inclusive of such early losses, otherwise it must be classed as unprofitable and its value be less than its cost.

In the case of a public utility limited as to its possible earnings by an extraneous rate fixing body unnecessarily to a sum less than sufficient to constitute a proper return upon the investment, it would appear that redress from this condition should be sought in the courts rather than by charging such losses to investment for a long period of years.

Save in so far as these losses may be said to be a measure of the cost of establishing the business, they do not of themselves, unsupported by other considerations, constitute a basis of value; and the most that can be claimed for them on their own account is that such losses from lack of revenue during the early history constitute the cost of and are, therefore, a measure of the value of that asset known as "established business."

Losses from abandoned structures from lack of sufficient revenue for refunding the money thus invested must be regarded as in much the same position as losses from inadequate interest returns from the same cause.

Such losses will, however, seldom accrue to the cost of establishing the business, for this should ordinarily be accomplished within the life of all structures of importance.

It is true that failure on the part of rate fixing powers to afford this revenue when it could reasonably be allowed without imposing excessive rates does a gross injustice to a water company, which should not be tolerated; but if such structures are permitted to long pass out of use without enforcing compensation for them they cannot be said to still have value save possibly as a moral claim.

The Degree of Prudence and Engineering Skill Exercised in the Acquisition of the Water Works Property and Their Relation to Value.—In considering this subject it is necessary to ascertain:

First: Whether no greater price has been paid for land and water rights than was reasonably necessary.

Second: Whether the structural works have been designed and built on sound engineering lines and with a proper regard for a wise economy.

The first calls for no special comment.

In passing on the second it must be remembered that no small part of engineering is the adapting of means to ends, that there are almost no established standards of design, that no two men will ever plan works along identical lines, and that a wide range of liberty of choice must be accorded the engineer.

The appraiser has a right to expect and demand that the works shall have proven reasonably successful considering all the conditions which have influenced or controlled their design and construction with average practice as his standard rather than his own personal preference. Beyond this he should be sparing of criticism. Unqualified failures due to inexcusable ignorance or bad judgment must lead to rejection in determining value, but the appraiser will often find difficulty in determining in his own mind where to draw the line between what is excusable and what inexcusable. If he is a man of wide experience he is least likely to indulge in hasty or harsh condemnations, realizing that engineering is very far from being an exact science; that to some extent it will always be the unexpected that happens; that defects are more easily discoverable under the test of actual trial; and that criticism is far easier than creation.

The Past Policy of the Rate Fixing Authorities in Making Provision for the Refunding of Capital Invested in Structures of Perishable Character, or Having a Usefulness Limited as to Time; and in Allowing Interest Returns on Property Acquired for the Future Use of an Increasing Population, and the Relation of Such Policies to Equitable Value.—Depreciation as ordinarily applied to water works results either from the wear and tear incident to use and exposure to the elements, or from enforced abandonment on the score of economy or of changed conditions.

For example of the first: Iron pipes are gradually rendered useless by corrosion until renewal becomes necessary; for example of the second, pumping stations may have to be abandoned because the water supply has become of uncertain purity, or because increased consumption, or later and better designed machinery renders the old unsatisfactory on the score of economy, even though such machinery may still be in as good condition as it ever was.

In any event depreciation represents a shrinkage or diminution of tangible property value which must be written off to expense as a part of the cost of maintaining the service and which must be paid for out of the revenues if the capital so invested is to be preserved unimpaired.

There are two ways by which this may be done.

First: By the establishment of a fund out of which all renewals and losses from abandonments are made good, the said fund being maintained by uniform periodical contributions from the revenues; or

Second: By meeting the actual expense of renewals and abandonments each year out of the revenues of the same or succeeding year.

Either policy preserves intact the invested capital and charges depreciation where it belongs as an item of expense.

The former method is for some reasons to be preferred, chiefly because it equalizes this item one year with another, thus permitting a more uniform water rate, and because it is the practice almost always followed, though in an indirect way. For most water works, unless prevented by restrictive legislation, make provision in their revenues each year for the redemption of a portion of their bonded indebtedness, and under all ordinary conditions such provision exceeds in amount and renders unnecessary the making of any other provision for depreciation.

It scarcely need be pointed out that a policy of making no allowance at all or of making insufficient allowance for depreciation, and then discarding the cost of the structures after abandonment in the determination of value for rate fixing purposes, is nothing else than confiscation, which by a process of gradual absorption tends to ultimately consume all the capital invested in such structures, with the result of having afforded water service to the consumers at just that much less than cost to the company.

The power that fixes the revenue determines the method by which depreciation shall be cared for, if cared for at all. If that power has made possible the provision of no fund for this purpose, but has, on the other hand, established the policy of allowing depreciation only as the renewals are actually made, the policy should be pursued to its logical and right conclusion and no structure when abandoned be disallowed in whole or in part in determining value until its cost shall have been in the same proportion refunded from the revenue.

Structures which have passed out of existence or which no longer serve a useful purpose may not be included whether the matter of their depreciation has in the past been rightly or wrongly dealt with.

Structures which are still useful should not be depreciated in determining value without provision being made in the revenues for refunding their cost.

When a charge is properly made against the otherwise value of a property because of structural depreciation, the amount of that charge should not be greater than the estimated present value of an interest bearing sinking fund which contributed to annually during the average useful existence of the plant will equal in amount the investment in the various parts at the end of their usefulness.

If it is the duty of a water company to use reasonable diligence to secure for the future as well as for the present an abundant water supply, a proposition seemingly beyond question; and if this can be accomplished most prudently by the acquisition of properties in advance of their actual requirements for the supplying of water, it certainly seems that such property before its development is in the true sense in use, since it has been purchased for and devoted to that purpose in recognition of the company's duty to the public.

If it has been the settled policy to include such properties, then the investor being relieved from risk and loss of interest in such investments might in fairness well feel that the public had acquired such rights as would warrant his accepting a lower interest return, or its equivalent, on the value of such property after it finally comes into actual use than otherwise. In other words, actual cost would then have greater weight in determining value for rate fixing purposes than the cost of an equivalent property.

If, on the other hand, it has been the established policy to exclude all property not actually employed for the supplying of water in determining value for rate fixing purposes, thus compelling the water company in the discharge of its duty to carry such properties it may be for years at its own risk, then surely this original cost has much less weight in determining their value when they do come into actual use—unless, indeed, cost be made to include also the losses of interest due to their retention—and the cost of other equivalent properties becomes of correspondingly greater importance in determining value.

It, therefore, logically appears that lands and water rights in general which of necessity are in the main secured and held long periods in advance of their actual use should in the determination of their values after they have have been brought into use have considered their cost inclusive of interest, and also the cost of acquiring a substitutional equivalent. The latter should establish the maximum and the former the minimum when below the latter, provided that the total valuation of the entire water works property does not exceed the value of the service rendered. Should cost with interest prove greater than a substitutional equivalent, it demonstrates imprudence for which the consumer should not be held responsible.

The Estimated Cost of the Reduplication of the Existing Structural Works and Its Relation to Cost and Value of the Existing Plant.—Previously herein has been pointed out the grave objections to adopting the theory suggested by this heading as the sole, or even paramount, consideration in the determination of value of existing structures when they are sought to be valued simply as structures separately and independent of their relation to the system as a whole.

Nevertheless it is proper to make such inquiry even though the actual cost of the existing structures may be known with certainty, for the answers will usually be serviceable in determining the degree of prudence and economic skill which has been exercised in the construction of the existing works. In other words, the answer to the query goes rather to the question of prudence in the expenditures actually made than to the value of the structural works in question. This is particularly true where the rate fixing authorities have pursued the policy of not allowing a revenue sufficient for safeguarding the actual investment in structures against subsequent falling prices and corresponding lesser cost of their reduplication at a later date.

Works of the magnitude here considered never are and cannot be constructed as of any particular date or any particular year. In determining, therefore, the probable cost of their reduplication it is necessary to forecast the prices of materials and labor likely to prevail at least during such period of time as would be necessary to carry out the assumed program. To make such forecast one cannot usually do better than to judge the future by the past and assume as a basis the general average of conditions which have prevailed for a period of years.

The Estimated Cost of the Construction of Substitutional Works and Its Relation to Value of the Existing Plant.—The estimated cost of constructing independent substitutional works has, for reasons already fully set forth, little relation to the actual value of existing structures save as such studies may throw light upon the question of the wisdom of the adopted plans after which the works have been built.

Unless such estimates can prove the existence of gross and inexcusable error in the adopted plans, they are not entitled to great weight in determining the value of existing structures.

In determining the value, however, of any combination of real estate and water rights which have together been made a source of water supply for which there exists a demand, the estimated cost of creating an equivalent from the next most available source becomes at least one measure within limits of the present value of the properties and rights already acquired and in use.

This proposition rests upon the theory that since such enhancement of value due to general community growth and prosperity, to which a water company so largely contributes, is in the case of individuals or private enterprises always regarded as legitimate gain, there seems absolutely no reason why the properties of a water corporation devoted by process of law to the public use for no more than a fair annual return upon its value should not share in such enhancement.

The writer has pointed out that this is entitled to special weight in determining the value of water producing properties when companies are compelled to carry them at their own risk and expense until such time as they are actually required for use.

Appreciation of Real Estate and Water Producing Properties and Its Relation to Value.—It seems clear that any determination of present value, if cost be used as the starting point, should be influenced by the appreciation, if any, that has taken place in real estate, water rights, and such like properties since their acquisition by the owners of the works.

It not infrequently happens, especially in the semi-arid sections of the country, that water rights and privileges and real estate so situated as to afford unusual natural opportunities for affording run-off and storage facilities of an exceptional character, though secured at comparatively small expense, through increased demand due to increase in population become in time of greatly increased value.

Inasmuch as such enhancement of values is always regarded in the case of a private enterprise as legitimate gain, and particularly since general prosperity, which creates such enhancement, is as largely fostered by a system of water works as by any other agency, there seems no valid reason why such increase of values above original cost should not accrue within limits to the advantage of the water company.

The actual determination of the present value of such assets must, of course, take into account the general scheme of which they form integral parts, and the final result as a whole to which they contribute.

No piece of property, however difficult it be to find a satisfactory measure of its value, can be counted as worth less than the cost of other as favorably situated tracts.

If this principle is applied to the combination of properties which because of their having been brought together have made possible the delivery for possibly all time of a suitable volume of potable water, then logically the amount of increase in value of such property or its present value would be sought in the cost of developing or otherwise obtaining an equally abundant and equally marketable supply from the next most available source.

This, then, is the justification for using the probable cost of a substitutional equivalent as at least strongly indicative of value.

This method will usually have its chief application and will most affect the final result in the case of those properties used for creating and safeguarding the sources of water supply as distinct from the distributing system, in those regions of the West where the water supply is the great problem.

On the other hand, where a community has at hand inexhaustible sources of supply free to any one at the cost of taking, water rights may have no value and no increase in excess of cost then becomes ordinarily possible.

Has the Franchise any Value?—The answer to this question depends upon what is meant by franchise. If a concern is actually earning revenue in excess of an amount sufficient to meet all costs of production, including a proper return upon the value of the property employed, it has become a very common practice to credit such surplus earnings to franchise. It cannot be denied that under such conditions, by whatever name it may be called, this ability to earn a large surplus, when it may be exercised, constitutes an important element of value.

It appears, however, that the creation of any earning power directly attributable to franchise under this definition, and the consequent creation for it of real value where it has cost nothing, presupposes the entire absence of regulation of rates on the part of government for the purpose of securing water service at no greater cost to the consumers than is consistent with fairness to the water company. In other words, franchise, if it has cost nothing, is not necessarily an element of value upon which any revenue need in fairness be allowed by rate fixing authorities. Indeed, the very purpose of the law, apparently, is to prevent such excess earnings as are here assumed to give value to the franchise.

If there are no legal restrictions, and a water company is allowed to collect such rates as seem to it alone expedient, it may easily be imagined that its earnings might in many cases be greatly in excess of what would net it a very reasonable, or even liberal, return upon the otherwise value of its property, no matter by what rational method such value were determined.

Again, when water companies have by wise foresight and prudent expenditure acquired properties, such for instance as lands and water rights, which by reason of their special adaptation to their purpose cannot be dispensed with without securing other properties productive of equivalent results at a cost materially in excess of the investments actually made, such enhancements of value have sometimes been credited to franchise.

This element of value has already been pointed out to be a very real asset; but it stands in a class by itself. To term it franchise value seems a misnomer, since it represents real value wholly independent of the franchise.

Again, the fact that a property possessed of and actually doing a large business capable of affording a sufficient revenue is worth more than a similar property without such business, has sometimes been termed franchise value.

This, too, while doubtless a real asset, is better classed as "established business," and will, later, be again referred to.

The writer is, therefore, of the opinion that the first before-mentioned view of what constitutes franchise value is the correct one; that every other element of real value is more properly classified elsewhere; and that under wisely drawn legal provision for the regulation of rates no value need attach to franchise either for purposes of taxation or revenue.

Does any Special Value Attach to the Fact That a Company Has an Established Business?—Mention has already been made of this element of value. It has been pointed out that a system of works already possessed of sufficient business to make the property a profitable investment is worth more than a similar property without a revenue.

That an established business constitutes a very real asset would seem to be beyond dispute, but the money measure of its value is so difficult of determination that it has at times compelled resort to mere arbitrary opinion. Such a procedure is always to be avoided if a logical standard can be found.

It does not appear that such a standard is wanting where proper accounting has been employed; and its reasonableness lies in the fact that it is rooted in the necessities of water works construction and growth as demonstrated by general experience.

This measure is found in the actual cost of establishing the business, as ascertained by the losses during the early history of the plant, arising from the want of a sufficient revenue to pay at least current rates of interest on the necessary investments. Reference has already been made briefly to this subject, but it is worthy a little further amplification here even at the risk of some repetition.

The building of water works suited to prevailing needs, with liberal allowance for future increase, is a work of necessity for any modern city, a work which, especially in the regions of sparse rainfall, must after the first nucleus is formed precede rather than follow growth in population.

A suitable water service must be obtained regardless of the magnitude of the necessary cost.

Because of these facts it almost invariably happens where local conditions render necessary heavy initial capital outlays, that to some extent the future must be discounted in the early financing of the enterprise. In other words, the limited number of rate payers makes it impossible for the enterprise to pay adequate returns on the investment until the population and business industry, increasing under the stimulus of an abundant water supply and other causes, make possible an adequate revenue.

What is to be the return for this unavoidable additional source of expenditure in the establishing of a sufficient business? Its result is the creation of this asset of "established business" and the attendant expense is an actual measure of what it has cost to create it by the only means by which such an element of water works value can be created. Cost is, therefore, a rational measure of the value of this element "established business."

The Value of the Service Rendered to the Public and the Limitations It Imposes Upon Value.—

The value of an established water works property, no matter how great may have been its cost nor how great a sum would be required to secure a substitutional equivalent, cannot in the final analysis be more for rate fixing purposes than the capitalization of its greatest possible net earnings without restriction as to charges. In other words, the worth of the service to the consumers will always fix a maximum beyond which no theory of value, however plausible it may appear, can be followed.

What is the worth of the service to the consumers and how may it limit the possible revenue, and thus limit the value of the water works property?

First: The service is not worth more to any consumer than it will cost him individually to secure an equivalent by pumping out of a well or from some other available source, if there be any; for if the rate charged exceeds this amount many will utilize such source in preference, with corresponding loss of revenue to the water company. The same holds good for all consumers collectively, save that in such capacity they may be expected to regard the public welfare as well as that of the individual.

Second: If there is no other possible substitutional supply, thus placing the water company in the position of having an absolute monopoly, still the value of the service rendered cannot be worth more than the consumer can afford to pay interest upon, without impairing general prosperity and checking municipal growth.

To illustrate the above truths: If a water company were wholly unrestricted by the governmental agency in determining the amount of its charges, it would be folly to impose rates so high, no matter how great its necessary investment, as to invite destructive competition; and if no competition were possible it would be just as foolish for it to injure its present as well as its future business by imposing rates so high as to check general prosperity and retard municipal growth. A wise policy and the one calculated to derive in the long run the greatest possible returns would always seek to keep well within these limits; and keeping within these limits, the property could not, for rate fixing, have a greater value than the revenue then received could support.

If the investment of the water company should prove in the long run greater than the value thus justified by the permissible rates, the loss is chargeable to bad judgment on the part of investors and they should not be heard to complain.

When one attempts an inquiry as to the value of the service rendered in the specific case of any city he finds himself, however, without any standards of exact comparison. Water rates charged in different places are indicative of general practice, but each is determined by widely varying local conditions and none may answer the question directly as to what is the maximum revenue that these local conditions would if necessary warrant. If, however, the rates in question are ascertained by comparison to be materially less than have been successfully imposed without evil results in other cities of comparable wealth and general prosperity, it may be inferred that the application of similar rates would in the case in hand be a safe procedure.

Again, if property improved and unimproved is enhancing rapidly in value it is evident that the imposing, if need be, upon it of an increased cost of water service would accomplish no worse result than to divide the so-called "unearned increment" due to general increase in population, in some proportion between water works and real property.

This phase of the subject then deals with the total gross revenues which the company should be allowed to collect, wholly regardless of the magnitude of its actual investment. Its application, therefore, requires the study of general taxation as well as that imposed upon the company, the amount of revenue paid the company in compensation for public service, the cost to the company of operating and maintaining its works, the provision, if any, which should be made annually for liquidating investments in perishable structures or others which ultimately require abandonment, and the rate of interest which the property is entitled to earn over and above all expenses.

While only general conclusions can be drawn from so complex a study, they can, with the exercise of care, be made sufficient to establish the limitations sought with a degree of accuracy suited to the demands of substantial justice.

Final Summarizing of Conclusions and Determination of Present Value.—Having considered the various hereinbefore enumerated factors likely to influence the value of any property under consideration, and having summarized the results, it will remain to determine the varying degrees of importance and weight to attach to each, and to decide in view of all the attendant circumstances what the amount is upon which the water company is entitled to receive a suitable return.

As has been stated at the beginning of this paper this final solution can never be reduced to a mathematical formula applicable to all cases. The before suggested inquiry will have established approximate limitations both as to maximum and minimum, but there will even then usually be found remaining quite a wide intervening field for the exercise of individual discretion.

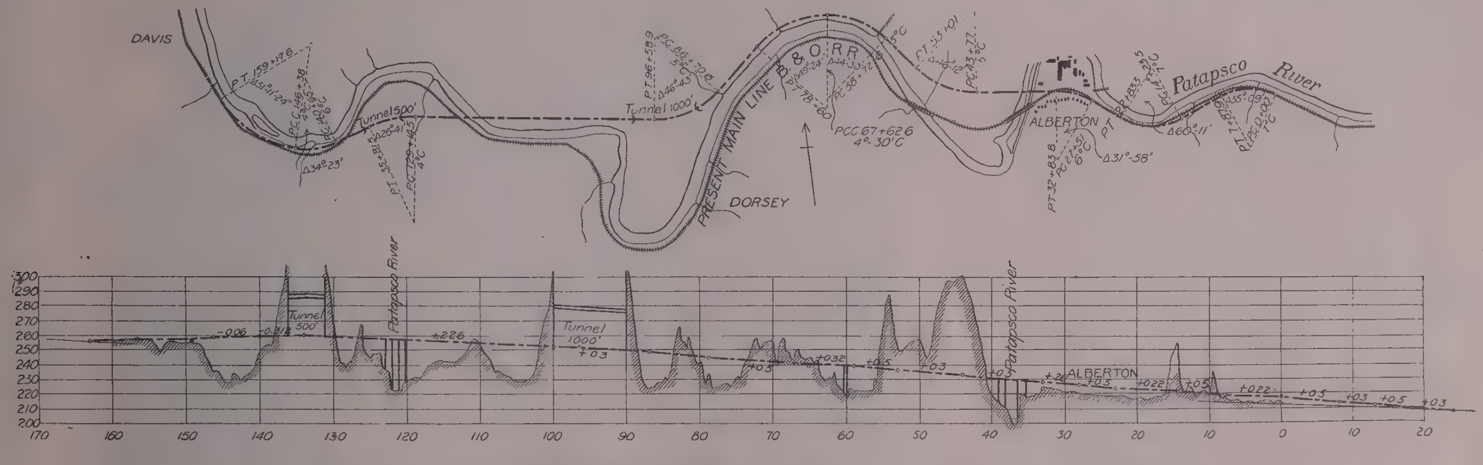
That the final result will so largely depend upon the personal equation does not of necessity detract from its worth. It only shows the greatness of the problem which requires for its solution the exercise of faculties higher than the application of mere formulæ and mere routine, faculties which are rooted in laborious thought, in ripe experience, in moral worth.

Justice in dealing with such highly abstract questions calls only for the best that can be had and nothing less; and the best will always be found sufficient for its ends, for this it is which determines our highest natural sense of justice itself, upon which all law must finally rest.

Important Rectification on the Baltimore & Ohio R. R.

The contract for the construction of a little over three miles of new track on the main line of the Baltimore & Ohio R. R., between Hollofields and Alberton, a short distance west of Ellicott City, Md., has been awarded to Messrs. Thomas A. Shoemaker & Co., of Pittsburg, Pa. This is the continuance of the work that has been going on for several years in straightening the alignment and making a low grade freight line from Relay to Washington Junction, on which over $2,000,000 has already been spent. This new improvement will cost between $600,000 and $700,000, and the contractors will begin on it at once.

It is an important piece of railroad construction that will include two tunnels, and some time will be required for its completion. It will be a standard double track line including one tunnel 1,000 ft. long and another 500 ft. long between a point west of Hollofields Station on the east and Davis Station on the west.



Map and Profile of Rectification Work Recently Undertaken on the Baltimore & Ohio R. R.

The present roadbed will be entirely abandoned and relocated, except for a distance a little less than half a mile, located east of Alberton, which will be raised and straightened. This improvement will eliminate 542 deg. of central angle and reduce the maximum curve from 12 to 7 deg., shortening the distance nearly two-thirds of a mile and reducing the maximum grade westbound from 0.9 to 0.5 per cent. It will place the roadway well above high water and free from damage by freshets, which heretofore have occurred almost every year.

The present road between Hollofields and Davis is an extremely bad piece of alignment, having a succession of sharp curves and in many cases reversing upon themselves, and which have been the cause of many derailments of cars and locomotives; then, too, the grade is laid so low that a proper waterway cannot be had at one of the crossings of the Patapsco River, with the result that from this source great loss has been incurred almost every year from high water and ice gorges. The new line will do away with all this trouble and add materially to the plan to make the old main line one of the best pieces of railroad in the country for the easy and rapid handling of freight traffic.

The Erection of the Wanamaker Store Building, Philadelphia.

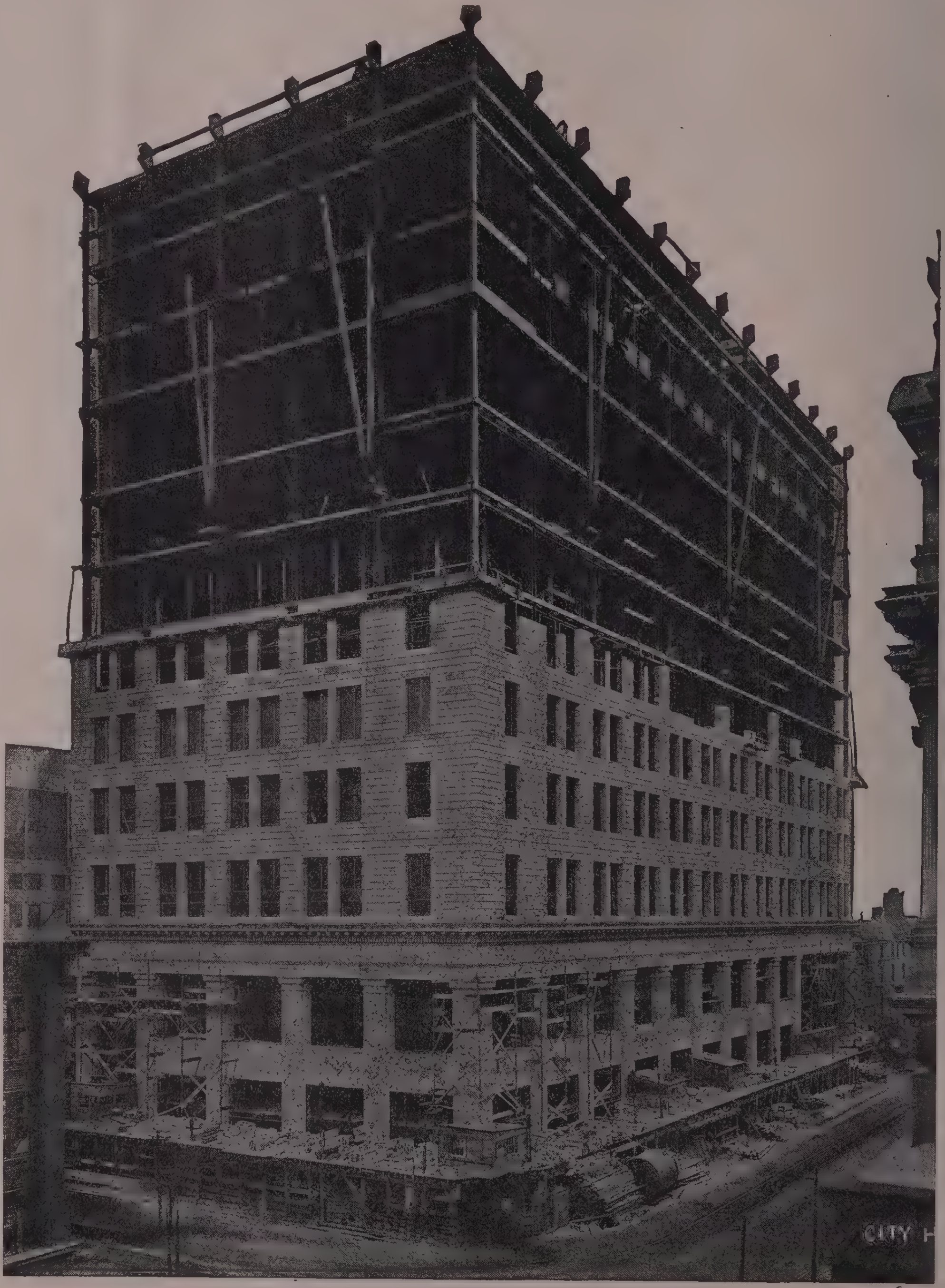
The Wanamaker department store occupies a full city block between 13th and Juniper Sts., and Market and Chestnut Sts., Philadelphia. The old structure consisted of a number of comparatively low wooden buildings with cast-iron columns and wooden floors. They were of different heights and consisted of originally separate structures connected together from time to time, thus making a very irregular framework. It was planned to replace the old store by a single modern 12-story steel-cage building about 246 ft. wide, 476 ft. long and 278 ft. high, with a 45x112-ft. interior center court. This building is now in process of construction without materially interrupting the business of the store. In order to accomplish this the new building has been divided into three sections. The first consists of a symmetrical L-shape fourth part of the building, covering all one corner included between the longitudinal and transverse center lines. The third section consists of a rectangular transverse strip about 170 ft. wide and 123 ft. long, containing the Chestnut St. front for the full width of the building and containing about 35 per cent of the building. The remaining 40 per cent of the building is included in the second section, which is L-shape in plan and surrounds two sides and part of the other two sides of the light court. Operations were commenced on section 1 without interrupting the business in the other part of the old building. After they had been carried as far as possible, that portion of the old building was abandoned and wrecked and the new structure erected there without interfering with the business in sections 2 and 3. When section 1 of the new building was completed, the entire sides were temporarily enclosed and business will be transferred to it while new section 2 is being built, after which the business from section 3 of the old building will be transferred to it and section 3 of the new building will be erected.

The basement of the old building was used for store purposes and was not disturbed by the operations of excavating under its floor and shoring up the old cast-iron columns so as to permit the old foundations to be removed and excavation to be made for the new cellar. Sheeted pits were carried down in the usual way to sub-grade and in them vertical timbers were set to take bearing in most cases on 1½-in. transverse horizontal steel pins through holes drilled in the columns just below the basement floor. In some cases, where the new piers or footings did not clear the center lines of the columns, cribs were built on each side and beams or girders were placed across their tops on each side of the old column to form a bridge carrying it over the free space required. The shoring was all completed and the new piers, except Nos. 7 and 8, were completed in sheeted pits while the regular business was carried on in the old building.

It was calculated that the general excavation could be accomplished while that portion of the old building was being wrecked, and after the business was moved out of it both portions were commenced simultaneously. A trench about 12 ft. wide was first dug and sheeted to sub-grade across Juniper St. front and the permanent concrete retaining wall was built in it. The excavated material and the concrete were handled by a traveling boom-derrick moved on track rails on each side of the trench. After the wall was completed, excavation was commenced from inside of it, working from a full-length transverse vertical face down to sub-grade. As soon as possible an inclined roadway 18 ft. wide was made adjacent to the retaining wall on the partly unexcavated earth sloped to the proper angle and covered with 3-in. transverse planks spiked to four lines of 10x10-in. longitudinal sills. At the top of this incline a Lidgerwood double-drum hoisting engine was set and operated by a 25-h.p. General Electric motor to haul out the spoil carts that were afterward drawn away by horses and mules. The soil was an excellent quality of sand and gravel, which was excavated entirely with pick and shovel by a force of about 300 men and 100 carts working night and day. The general excavation was carried down to a depth of about 34 ft. below the curb and about 24 ft. below the former excavation. A large amount of ground water was encountered about 8 in. below the top of the new sub-basement floor and about 15 ft. above the bottoms of the deepest pits, and constant pumping was necessary to remove it. A 10x10-ft. sump was at first excavated to a depth of 55 ft. below the curb in the center of section 1 and in it was installed a Riley pump with an 8-in. discharge. The pier pits were sheeted with 3-in. tongue-and-groove yellow pine vertical planks and 10x10-in. horizontal waling pieces and were made with a clearance of 1 ft. on each side of the piers, so as to allow room for the concrete molds inside of them. One sump was dug adjacent to each pit and in it was installed a Barr, Riley or Worthington pump with a discharge pipe 4 in. or more in diameter, which sufficed to drain the pit until the concrete was laid in it.

All concrete was mixed by hand on platforms adjacent to the piers where it was placed. It was made with Vulcanite and Alpha Portland cement and was proportioned 1:2:4 for the piers and 1:3:6 for the retaining walls.

The beams and grillages for the foundations in section 1 weigh about 1,800 tons, and were set without derricks by the use of rollers and jacks before the old building was wrecked. The erection of the steel superstructure was commenced when Mr. John Wanamaker set the first column July 11, 1904, and the erection of 7,000 tons of steel in this part of the building was substantially completed in 12 weeks, including 11 days of lost time.



Construction of First Section of Wanamaker Building.

The steelwork was all erected by three special guyed derricks and one gaff derrick, that is, a standard boom rigged to one of the steel columns of the building, which served as a mast.

The derrick booms all had a capacity of 40 tons and a length of 64 ft., and were made with special fittings, as illustrated in the description of the Wanamaker power house, published July 29. These derricks handled the very heavy column sections with a maximum weight of 20 tons each and also lifted the 67-ft. plate girders weighing 16 tons, which occurred in all of the upper floors. The derricks were operated by Lidgerwood double-drum hoisting engines and were driven by 40-h.p. General Electric motors first made to the Thompson-Starrett Company's order for this work.

The gaff derrick was operated by a double-drum Mundy engine, for which an electric motor could not be secured in time, so it was driven by the compressed air provided for the pneumatic tools. The derricks with their rigging weighed about 12,000 lb. each, and were shifted every second story by a gang of 12 men who handled them so skilfully that they were out of service for a minimum of only 3 hours for every movement. The steelwork was erected at a maximum rapidity of 2,000 tons per week and at an average speed of two stories in 8 days. From 100 to 150 men were employed one 12-hour shift daily. About 200,000 ⅞-in. field rivets were driven by 15 Chicago pneumatic hammers operated by air from a Chicago pneumatic air compressor fitted with a Cutler automatic regulator to open and close the steam valve when the pressure fell below or exceeded 100 lb. in the reservoir. All steam used on the work was furnished by the Wanamaker power plant.

During the erection of the steelwork a foreman, with three four-man gangs, was kept continually busy plumbing the columns. This was done from the corner columns, which were plumbed to position with their centers 2 ft. from the instrumental line produced from permanent bench marks for the building line. No columns were less than two stories high and their tops were secured by ⅞-in. to 1-in. steel temporary guys which, for the corners, crossed one column and were attached by chain slings to the second wall column and floor beam or girder. Each diagonal had a turnbuckle for adjustment and enabled the top of the column to be very exactly set. In some cases, when the column was inside the required position, inclined struts and jacks were used instead of tension diagonals. The tops of all the intermediate wall columns were similarly plumbed by diagonal wire cables or struts, the former reaching across two intermediate columns, to which they were clamped at intersections. The beam and girder connections were so closely fitted that they accurately governed the positions of the interior columns and very few of the latter needed special plumbing. All the columns were so stiff that after once being plumbed they retained their positions without further attention. The columns had a total height of about 278 ft. from foundations to roof, and were thus set so accurately that no adjustment was necessary for the elevator guides, a result which was considered remarkably satisfactory. All structural steel was painted at the shops and in the field with two colors of Dixon's Silica Graphite Paint.

Three weeks were required to wreck the old building, and the exterior walls of the new building were commenced when the steel erection was completed to the third floor. After the erection was completed, the inner sides of this section were closed by temporary partitions made with 100,000 sq. ft. of 24-in. galvanized flat iron with bent lock joints fastened to 2x6-in. vertical wooden studs 22-in. on centers. These were anchored to the column and beam flanges by cold-bent soft iron strips 2 ft. apart on centers. The studs were lined on the inside with tar paper and ⅞-in. horizontal tongue-and-groove sheeting covered with canvas.

D. H. Burnham & Co., Chicago, are the architects of the building, Mr. J. G. Giaver, structural engineer, and Mr. L. T. Burnham superintendent of construction. The contract for shoring and wrecking the old building, for the temporary foundations, masonry and structural steelwork was let to the Thompson-Starrett Co., Mr. George Simpson, chief engineer, and Mr. J. Cummings, superintendent. A portion of the shoring was done by H. Sheeler & Sons, of Chicago, and Mr. Rondeau, of Chicago, and some of the excavating and concrete work was done by the Vulcanite Co., of Philadelphia. The Thompson-Starrett Co. commenced operations about the first of June, 1904, and this section of the building was ready for partial occupation Dec. 1, 1904. It is planned to erect the second and third stations in substantially the same manner as above described, commencing section 2 June 1, 1906.

Reinforced Concrete Works in Belgium.

Belgium has witnessed the construction of a number of rather unusual structures of reinforced concrete, and at the recent meeting of the Institution of Mechanical Engineers at Liege, some of them were described briefly in a paper by M. Ed. Noaillon, of Chênée. The first was the dome of the Central Railway Station at Antwerp. This dome springs from the level of the roofs of the mass of buildings of the station at a height of 130 ft. about ground level and rises another 130 ft. to the spire. It is entirely constructed of reinforced concrete by the firm of Vasanne, of Brussels. The work was originally to be built in stone, but it was discovered that the foundations would not carry such a weight, and therefore ferro-concrete was preferred, as it could be built hollow. However, it was necessary to follow minutely the form of the original design, which, rationally conceived for a massive material like stone, often presented serious difficulties of execution in ferro-concrete.

The dome comprises four large glass lights placed upon the sides of a square, and upon these rests the actual dome which in its turn supports a campanile. Each glass light is in the form of a gallery with seven arcades surrounded by a demi-arch of 32.8 ft. radius. The arches are framed by an archivault of 11.5 ft. height, which receives at its periphery the haunches of the dome.

The entire structure, which is 1,800 tons in weight, rests entirely upon the columns at the angles of the glass lights, for it was only at these points that a solid support could be obtained. These columns are Y-shaped in the cross section, which has an area of 10.7 sq. ft., and they are sub-divided at the height of the centers of the arches into three beams.

The tail of the Y is extended in the diagonal plane in the form of a thrust block rising obliquely between the two shells of the dome. Each of the limbs of the Y forms the abutment of the beams in the arch, 8.2 ft. high, situated in the archivault. In the horizontal plane passing through the tops of the archivaults is placed a beam in the form of a flat ring 4.92 ft. wide, which is supported at eight equidistant points, which are the four tops of the archivaults and the four ends of the thrust blocks.

This beam serves two purposes—it balances the horizontal reactions due to the obliquity of the thrust blocks, and resists the tensile stress created by the joists of the dome. At the top of each beam of the archivault are hooked two tie-rods which go down in the two midribs of the arches and extend into the two central columns of the gallery of arcades, and support in its place a horizontal beam hidden in the entablature of the gallery, and supporting all the lights; it is obvious, therefore, that all the weight of the latter is supported by the columns.

The dome consists of two superposed shells at a distance apart varying from 3.28 ft. to 6.56 ft. The internal shell which forms the ceiling of the entrance hall is completely decorated with sunk moulded panels; some are round and others square, and they diminish in depth and size progressively from the springing to the summit.

They leave only flat bands on the inside of the shell, and these follow a series of meridians and parallels. A part of these flat bands are formed by a skeleton of joists and trimmers which are supported on the annular beam, and they carry the whole weight of the dome. This skeleton was first erected, and served to support the cores which formed the moulds for the panels, and then the latter were filled in with concrete.

The external shell has a uniform thickness of 3.15 in., and it is relieved by six moulded ribs following meridian lines. It is supported upon the internal shell by small distance pieces normal to the two surfaces; this method of support has been chosen to allow as much freedom as possible for the unequal expansion of the shell owing to the rays of the sun striking it obliquely.

The most interesting feature of the construction of the dome of the Antwerp station is that all the mouldings and all the sculptures, which are so numerous and of so many different forms, have been executed by direct moulding, and not, as is usually the case, by rough applications which are trued up afterwards by gauge boards. It would never have been possible to make in wood the numberless moulds which would have been needed for the latter process, particularly as the work had to be done upon surfaces bent often in two directions like the panels of the dome.

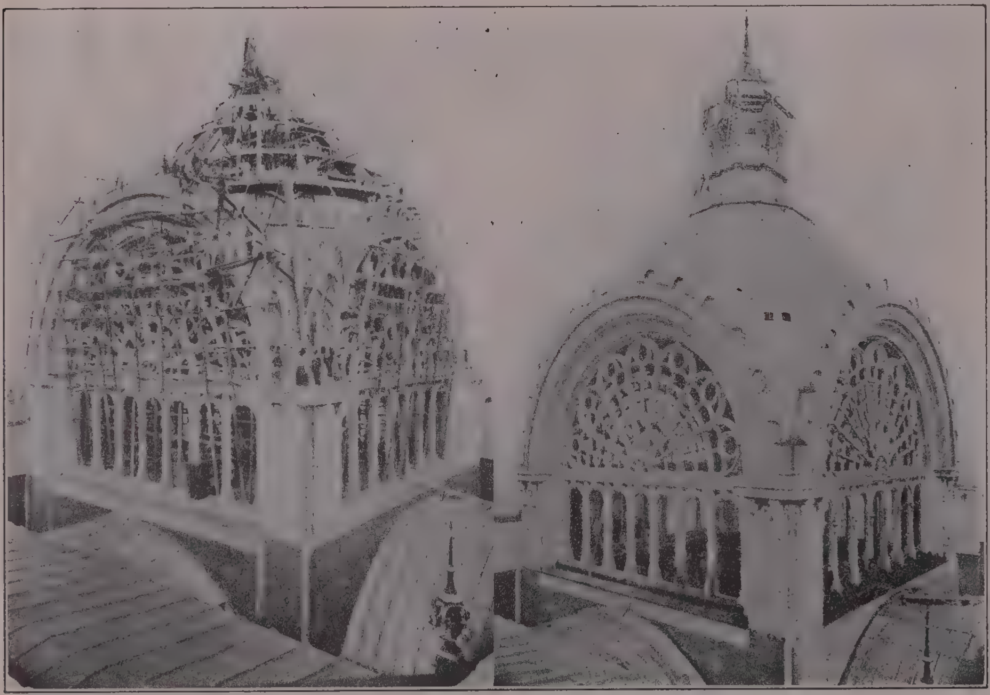
M. Vasanne has invented a very ingenious system of moulding. He begins by executing in plaster the model of the sculptures which are to be reproduced in the concrete. He then spreads upon this negative mould a layer of 1.2 to 2 in. thickness of a paste made of sawdust and magnesium oxychloride. This paste hardens rapidly and gives him the desired mould, which is light, strong, and can be worked like wood; the same negative mould can be used several times.

The manufacture of the glass lights was specially difficult because of the great richness of the ornamentation and of the exactitude with which the moulds had to be made to obtain a perfect fitting of the different mouldings. The part of the glass lights which forms a gallery was filled with concrete at one operation in a mould built up in position on the site. With regard to the part in the form of a half rose, a complete mould was arranged upon a perfectly level platform. This mould showed, therefore, in hollow all one face of the half rose.

The concrete was moulded to a thickness of 2 in., and then the moulded part was cut into portions specially marked. Then the moulding, followed by the same division into parts, was repeated to obtain the opposite face. In this way two corresponding portions placed back to back formed one hollow structure representing one element of the glass light. The parts were then used to build up the light, just as stones would have been employed, but care was taken to pass bars of iron into the hollow part, and then to pour in concrete, so as to obtain a monolithic structure which possesses great rigidity.

The second important structure described was the Renommée Hall at Liege, built entirely of reinforced concrete by the firm of Perraud & Dumas, of Brussels. In contradistinction to what took place in the design for the dome at Antwerp, the general arrangement, the style and proportions of all the parts of the building were specially thought out by the architect, M. Jaspar, so as to be the most suitable for construction in reinforced concrete, and in order to use the properties of that material to the best possible advantage. It was desired to oppose the tendency to make concrete merely play the part of a servile imitator of stone, by the employment of a characteristic design which should indicate the nature of the material used.

The principal hall is covered by three cupolas, each 55 ft. in diameter, placed at a height of about 50 ft. above the level of the ground. Each cupola forms part of a sphere which continues in haunches pierced with lights and descending to the corners of the circumscribed square. The intersections of the spheres with the vertical planes passing through the sides of the squares are formed by arched beams which spring from the capitals of short cylindrical columns. The cupolas are 4½ in. thick and are made of concrete composed of cement and clinker finely broken up; they are reinforced by a layer of expanded metal and with a lattice work of bars. The centering of the first cupola was carried out upon a new design. In order to avoid the great expense entailed by the construction in wood of a spherical centering, a skeleton was built up of ironwork consisting of 16 bars, each 1½ in. diameter, fixed upon the meridian lines like the ribs of an umbrella, and these were interlaced upon parallel horizontal circles by other weaker bars. The whole skeleton was then covered with sheets of expanded metal, which were designed as the first reinforcement, and afterwards the concrete was put on above and below so as to completely surround the expanded metal, which thus acted as its own centering, and it was merely necessary to render the surface up to the required thickness. The bars of the skeleton were then removed and used for the other cupolas, and they were finally intended for reinforcing the beams. Unfortunately this system of centering was found to be wanting in rigidity, and it was necessary to use the wood centering after all.



The Dome of the Antwerp Station during Construction and Completed.

The roof of the galleries and the spherical triangles between the cupolas form a terrace of 957 sq. yd. area, which serves as a promenade. The concrete of the cupolas and the terraces is not rendered in cement, but made water-tight by a large layer of rubberoid.

The principal hall is lighted upon its two long sides by six semi-circular glass lights, each 52.5 ft. diameter, framed by arched beams. The spandrils are formed by panels of ferro-concrete showing on the inside ornament in relief; the moulding was done in the workshop, and then each panel was cut into portions that were erected in position.

The Interior of the Renomme´Hall at Liege.

The third undertaking described by M. Noaillon was the widening of the La Boverie Bridge at Liége. This bridge is 147 yd. long. The width has been increased from 32.1 ft. to 46.3 ft. by means of two platforms corbelled out at each side of the bridge. At each end these platforms are extended so as to meet the quays by wide quadrants.

The corbelling is carried out by a platform 5.9 in. thick, supported at intervals of 6.56 ft. by brackets 11.8 in. thick, by 19.7 in. in height at the back. The method of fixing these brackets is interesting. Cutting and pinning brackets into the old structure presented serious difficulties, as it would have been necessary to cut deeply into the ashlar work and to destroy the keystones in the arches, which would have been very unwise. The author of the design, M. Prangey, engineer of roads and bridges, got over the difficulty in a very satisfactory manner by fixing the brackets in pairs opposite one another. The brackets were made independently two months before they were needed; the three round bars, 1.22 in. diameter, which formed their reinforcement in tension, were left projecting beyond the concrete about a yard, and the ends were threaded. The brackets were put in position, a pair at a time, by means of two cranes, and as soon as their bases had been entered into the recesses cut in the masonry of the bridge the ends of the three pairs of bars were coupled together by means of three tie-bars which crossed the roadway, and these tie-rods were provided with long sleeves threaded to fit the ends of the screwed bars. In this way each pair of brackets were mutually self-sustaining, and the cranes could leave them fixed. It was merely necessary then to level them up carefully by tightening or slackening the screwed sleeves, and then to pin them permanently in position by running in cement grouting round the ends of the brackets in the masonry.

All the tie-bars are embedded in a layer of concrete 6.3 in. thick, which extends across the roadway and serves to constitute the gutter to carry off the water which percolates through.

The platform, which is supported by the brackets, is calculated for a distributed load of 80 lb. per square foot, and was tested up to 160 lb. per square foot without suffering any appreciable deflection.

The fourth structure described was the bridge at La Boverie Island on the Branch at Liege. This was built on the Hennebique system by the Dulac Co., under the direction of the engineer, M. Prax. The chief details of the work are: Length between abutments, 260 ft., comprising a 180-ft. central span and two 32.8-ft. side spans; width of roadway, 32.8 ft.; ratio of rise to span, 1 :85.

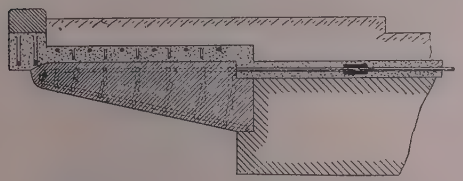
One of the special features of the bridge is that it is built upon foundations constructed by the method of mechanical compression of the soil, described in The Engineering Record of Sept. 4, 1897. The piers and abutments rest upon a group of concrete piles driven deeply into the bed of gravel, which is strongly compressed by the method adopted. The piles are re-inforced by vertical bars of steel which are continued into the piers and abutments, so that the whole is solidly bound together. The advantage of this method is to solidly root the bridge into the earth, so that it has a resistance amply sufficient in case of a floating accumulation of ice occurring which temporarily transforms the bridge into a dam.

From the point of view of its construction the bridge is considered as a cantilever with unequal arms, the shorter arm balancing the longer by the weight of the abutment.

The roadway is a platform 7.9 in. thick, and forms a tension member by means of its reinforcement, and it is supported by the arches which form the struts. In the neighborhood of the keystone, and for about 82 ft. in length, the roadway is solid with the arch of the principal span. This arch is 2.46 ft. thick at the haunches, and 1.97 ft. thick where it dies into the roadway; it diminishes farther until at the crown the roadway and arch together are only 1.15 ft. thick. In the parts adjoining the pier, where the vault is clearly separated from the roadway, the latter is supported by three vertical struts 7.85 in. thick; one is the axis of the bridge, and the other two forming solid spandrils. The width of the arch being only 18 ft. the sidewalks are carried upon brackets 7.4 ft. long. The roadway is covered with asphalt, and the sidewalks are paved with artificial stone.

The fifth structure described was the framework for lead chambers at the chemical works of the Engis Co., Ltd. This company, under the advice of its managing director, M. L. G. Fromont, who is an engineer, has adopted reinforced concrete for the construction of various foundations and for the construction of tunnels, cellars, platforms, hoppers, silos, frameworks for lead chambers, and for various towers, such as are required in the Glover and Gay Lussac processes. Among the interesting applications should be specially mentioned the framework for lead chambers, which constitutes one of the boldest innovations not only in the method of construction itself but also in the special apparatus which are enclosed.

It is known that the most modern constructions designed to shelter and support the lead chambers are essentially composite structures, generally made of brick in the lower portion and in iron and wood for the upper portion. The combination and connection of the various heterogeneous parts present many weak points at the lines of meeting; joints and connections for all these junctions represent so many points for attack either by the sulphur gas, or by sulphuric acid when an accident has happened. Besides this, the enormous quantity of wood used for this kind of structure makes them highly combustible, and exposes the manufacturer to serious risks. These disadvantages alone suffice to justify the use of reinforced concrete, and the structure built at Engis, from designs prepared by M. Faure under the guidance of Prof. Henri Deschamps, constitutes really a monolith from the foundations to the summit without joints or discontinuity. From the point of view of resistance to gas and acid liquids the composition and treatment of the concrete has been the subject of special study, and the mixtures employed have given perfect satisfaction.


Cantilever Bracket, La Boverie Bridge.

It was impossible for the author to give either a plan or photographic views of the interior of these chambers, for their special arrangements, which are due to the investigations of M. Fromont, are technical secrets which cannot be divulged. The structure occupies in plan an area 230 ft. long by 92 ft. wide; it has a total length of 82 ft., of which 23 ft. is for the lower portion and 59 ft. for the upper part. The lower portion is formed of piers placed 16.4 ft. apart, each consisting of four columns connected at their upper ends by a horizontal girder 92 ft. long aided at various points by struts fixed to the base of the columns. The total load carried by the lower structure is about 3,700 tons. At certain points the girders are connected together by joints, and there is a flooring of reinforced concrete which serves as a footway all round.

The superstructure consists of vertical columns 59 ft. high, which rise from the ends of each horizontal girder, and besides these there are also columns in the center of the building. At the upper part all the columns are connected together by horizontal girders with a span of 44.5 ft., and each of these bears a distributed load of 45 tons. The horizontal connections of these girders form the roof terrace. The columns are solidly connected together by vertical partitions of reinforced concrete, which, in conjunction with various well-designed struts, give the desired rigidity to the entire structure. The building was erected in 1900, and since that date has been in constant use and has given no trouble whatever. Another marked advantage possessed by this building is that, owing to the careful distribution of the materials, which are calculated with ample factors of safety, as was proved by rigorous tests, it has not been more expensive to construct than the old unsatisfactory composite buildings already described.

Some Experiments in Waterproofing Solid Floor Bridges.

The work of grade crossing elimination in Chicago during the last 13 years has brought out clearly the importance of a waterproof floor. Years ago, when a solid floor was considered the same as a shallow floor, water-tightness, the preservation of the steel, and noiselessness were found to be impracticable of attainment. The last requisite is increasing in importance, and the shallow floor is disappearing rapidly in consequence of the necessity of using ballast between the ties and steel work to deaden the sound. This change in construction has introduced new problems in waterproofing and steel protection, and some important investigations of them have recently been made by Messrs. N. Neff and C. L. Barnaby of the maintenance of way department of the Pennsylvania lines. These were conducted on a number of bridges in Chicago and its suburbs and are explained in detail by Mr. W. C. Cushing, chief engineer of maintenance of way of the company, in the June "Bulletin" of the American Railway Engineering and Maintenance of Way Association. The detail of the various types of construction tested is too great to be described here, but the conclusions drawn from the experiments by Mr. Cushing are as follows:

Asphalt mastic is not suitable for filling the troughs of solid floor bridges, because of its shrinkage when cooling, thus defeating the objects of its use, protection of the steel, and the formation of a solid, compact mass, with such close adherence to the steel as to be watertight. It is felt that ample trial was made of it, and that, too, with different mixtures of the best asphalt to be found. The advice of the manufacturers or dealers was freely accepted, till it was discovered that they were simply experimenting.

It is quite within reason to consider, in the light of the tests, that an asphalt covering next below the ballast, either over mastic or concrete, is not an efficient water-proof coating. When the inspection was made in January only one bridge prepared with this was not leaking. The requirements of ductility and hardness conflict. When the asphalt is made soft enough to resist tearing apart under temperature changes, it is too soft to bear the load of traffic, a fact which has been also proved on other railroads. It is impossible to provide for a sufficient depth of ballast to overcome this objection.

Ordinary concrete has not sufficient strength in itself to resist the forces tending to tear it apart at the column lines of bridges in two or more spans. Consequently leaks developed at every place of that kind. Although it has not been proved by trial, it is quite likely that reinforced concrete will prove effective.

Concrete is an effective filling material for troughs, because it adheres firmly to the steel, protects it from corrosion, and can be made practically water-tight, either by the use of concrete, rich in mortar, or by a solution of soft soap and alum. Its objections are that it is: (a) Difficult to remove in case repairs are necessary, or in view of the replacement of, or addition to, the bridge, on account of constant improvements in the property. (b) Heavy, and adds considerable dead weight to the bridge. (c) Costly, on account of the quantity, and the great care necessary to make a satisfactory job.

Something more than filling the troughs is necessary, however. A top surface is required, graded to carry the water to the sides and to the ends of the bridge. Concrete alone is not suitable, unless in considerable thickness. To meet this condition, it must be reinforced.

The Hydrex felt covering has given no cause for complaint, but this is a case where time is especially needed to determine the result, because its effectiveness depends on its strength against puncture by the ballast, which is a very thin layer under the ties. It has been much used by the Chicago & Western Indiana R. R. If, however, the Hydrex felt should be broken up by the ballast, there is a remedy, where there is a sufficient depth of ballast, by laying a concrete sidewalk on top of it to bear the loads transmitted by the rolling stock. This concrete need not be water-proof.

In the case of trough floors transverse with the tracks, there seems to be no help for it except to fill them up with a rich concrete, unless indeed a drain hole is cut in each, and a gutter underneath be provided, a plan which should not be resorted to except in case of necessity for a long bridge. After this is done, one has the choice of several different ways for providing a water-proof covering.

When the troughs are placed parallel with the track, a much less thickness of concrete filling can be used, if a suitable method for protecting the portions of the troughs sticking up above the concrete can be devised. It is quite certain, where columns are used, that the concrete must be reinforced at the column lines, and other expansion places. If a plaster of cement is put over the exposed troughs, it may possibly have to be reinforced also, on account of its thinness.

Sewage Treatment Experiments before determining the designs of a disposal plant for a large city are advisable because the sewage of each community possesses characteristics more or less peculiar to itself. This was pointed out in a recent paper by Mr. G. A. Johnson, who had charge of the Columbus testing station. "Some sewages are very strong, while others are very weak, owing to the leaching of ground waters into the sewers, or to the extravagant use of water on the part of the citizens of the community in question. It is very rare indeed that the sewages of two cities are found to be the same in composition. All of these things, some more than others, influence the character of the treatment which will cope most successfully with the problem of purifying the sewage of a given city. There are at this time over a dozen different methods in use for the purification of the sewage of cities and towns in this country, each one presumably being particularly fitted to meet the requirements of local conditions."

The Significance of Analyses of Effluents from Sewage Works.

The interpretation of the analyses of effluents from sewage disposal works is a matter that is best left to analysts. The engineer has to venture on such interpretations so often, however, that attention is called to a paper on the subject by Mr. Earle B. Phelps in the "Technology Quarterly" for June. This paper is a rather long contribution from the sanitary research laboratory and sewage experiment station of the Massachusetts Institute of Technology, and the following notes give only the leading statements of the author under each head:

The subject of the quality of the effluents derived from a sewage filter has been considered from two totally different points of view, which have led frequently to conflicting opinions as to the results obtained. One view is based upon the actual work of the filter expressed in percentage efficiency, and necessarily takes into account the nature of the raw sewage. The other is based upon the quality of the effluent as shown by the analysis.

The expression, "percentage removal," sometimes called the efficiency of the filter, is of very little value in the comparison of systems which are not receiving the same sewage, for it is much easier to get a high efficiency, calculated in this way, on a strong sewage than on one which is weaker. On the whole it would seem that a better interpretation of the analysis of an effluent can be made than this customary comparison with the raw sewage. A direct comparison of effluents derived from the same sewage will serve the purposes of the investigator fully as well as a comparison of the efficiencies, while the quality of the effluent is the final and practical criterion upon which the work of the filter must be judged.

Since the introduction of the more recent biological processes our ideas of purity of effluents have been gradually changing. In many of these processes, but most notably in the case of the continuous, or trickling, filter, a large amount of organic matter is passed through the filter, which upon examination generally proves to be of a peaty or humus nature and incapable of further putrefactive change. Aside from the possibility of such material creating a nuisance by forming deposits behind milldams or in the lower reaches of the stream, it appears to be entirely harmless and nonoffensive. Chemical analysis fails to distinguish between the ordinary putrescible matter of sewage and this non-putrescible material which results from the treatment of the sewage in the manner indicated. This has led to the introduction of putrescibility, or incubation, tests which are now so commonly used. These depend, in general, upon the storage of the effluent in a bottle at summer temperature and out of contact with the air for a period of several days. Certain tests are then made upon this incubated sample to determine if it has undergone putrefaction. The determination of the oxygen consumed before and after incubation is the one most frequently employed. Many chemists determine the loss of dissolved oxygen and of nitrates either in the original effluent or after mixing it with certain quantities of aerated water or nitrate solution.

Attention has been called to the value of the nitrates in an effluent. Instead of adhering to the older view that all organic matter is harmful and must be kept below a certain maximum standard value, the more recent practice is to balance the available oxygen against the organic matter, and, if the former be found in excess, to consider the effluent satisfactory. The question remaining to be settled, and on which there are many views, is just how much of the oxygen is available and how much of the organic matter requires oxidation.

There is a school of sanitarians who hold that, if a partially purified effluent can be supplied with sufficient available oxygen for the complete oxidation of the remaining organic matter, it may with safety be discharged into the stream, and the purification will be completely carried out within the stream. In justice to this view, it should be stated that what is here attempted is apparently not the protection of the streams from pollution by disease germs so much as the prevention of an apparent nuisance in, or fouling of, the stream. The evident intention is to keep the stream in such a condition that it may be rendered fit for domestic use by further purification of the water.

With our present knowledge, at least, this would seem to be the wiser provision. We know little, unfortunately, of the viability of disease organisms in sewage and of the effect of purification treatment upon them. While the ideal condition, and the one toward which sanitarians should ever be working, is the perfect purification of sewage from all pathogenic bacteria before discharge, it may nevertheless be better economy, with our present information, so to purify our sewage as to prevent it from seriously fouling the streams and to thoroughly purify all waters taken from them for domestic use.

Nitrogen.—According as the conditions of the purification process are aerobic and anaerobic, the nitrogen of the organic molecule may follow one or the other of two very different courses. In the slow sand filter and also in the percolating, or trickling, filter, in both of which types there is a plentiful supply of oxygen, the course of all the nitrogen seems to be from organic molecule to ammonia, and thence to nitrites and nitrates. In a very good sand filter as much as 99 per cent of the organic nitrogen may thus be accounted for. On the other hand, in the contact system of purification, while as much as 25 per cent of the total nitrogen may follow this course, a large part of the remainder is converted, under the anaerobic conditions of the reduction phase, into the amine form, and that these amines in turn react with the nitrites previously formed. This reaction causes a liberation of a large percentage of the total nitrogen in the form of the free gas. As much as 50 per cent of the total may thus disappear. In the septic tank also nitrogen is liberated, but in this case the liberation is brought about by the direct action of the micro-organisms upon the organic molecule. Knowledge of the actual amount of nitrogen escaping from the septic tank or from a contact filter is obviously of great importance, and the value of the total nitrogen determination as an index of the work of these processes is evdient.

The free ammonia being a transition stage in the purification process is not of much significance in those rapid processes of treatment where a large amount of ammonia is produced in a short time. In very pure effluents, such as those from sand filters, the free ammonia being extremely low, is a valuable index of the work of the filter. In such cases it may be said that it runs very nearly parallel with the organic nitrogen as well as with the bacteria.

The nitrates are likewise transition substances, and are extremely unstable. In filters of the oxidizing type, nitrites are a valuable indication of the condition of the filter. When such a filter is running at its best, the nitrites will, as a rule, be low. A marked increase in the nitrite value is then an indication that something has gone wrong with the filter. Considered with reference to the stream, they are of value in that they possess available oxygen, although as a rule the amount of nitrites present is too small to be of any value in this respect.

Nitrates are the final product of the oxidation of the organic nitrogen. Their appearance in sand and trickling filters is, therefore, of great significance, in that they indicate the actual amount of work done by the filter. Their relation to the quality of the effluent is also important. They carry the largest amount of the available oxygen of the effluent, and it is now believed by most authorities that they may be entirely consumed in the process of secondary oxidation, which takes place in the stream after the discharge of the effluent. Any arbitrary standard for purity for effluents from such filters should therefore contain, in addition to a maximum allowable amount of organic matter, a minimum amount of nitrates. In such a case mere dilution of an effluent could never bring it to the desired condition, while with high nitrates an effluent will not generally become foul or offensive by secondary putrefaction. Authorities are not yet in agreement as to the significance of nitrates in the contact filter effluent. Mr. Phelps' opinion is that since nitrates are used up in the work of the filter, their appearance in the effluent merely indicates that an excess has been formed, and that if necessary the filter may be worked harder. Perfectly stable effluents may be obtained practically free from nitrates.

Carbon.—The organic carbon is determined only partially by the oxygen-consumed test. While this test has a certain value in the comparison of effluents from similar filters, and especially as a quick method for controlling a filter, it has no scientific basis whatever, and the relation of its results to the total carbon is unknown. The oxygen-consumed determination is of undoubted value in the putrescibility tests.

Oxygen.—Free dissolved oxygen in the effluent represents a reserve oxidizing power by which the effluent can further purify itself. Its presence also indicates that there has been a sufficient supply of this necessary element during the process of purification. The effluents of oxidizing filters, sand and trickling filters, should always contain free oxygen. If all the oxygen is used up, then the process is not being properly worked. In the contact-filter effluent the free oxygen has another significance. The supply of oxygen being necessarily somewhat limited in this type of filter, it will become most completely exhausted in that filter which is doing the most work.

Putrescibility Tests.—By putrescibility we denote that property of the organic matter in a sewage or effluent which causes it, under certain conditions, to undergo putrefactive change. For the purposes of sewage work, the organic matter dealt with may be roughly grouped into these two classes, for it is now generally conceded that, in addition to the readily putrescible organic matter which characterizes sewages, there is also found in effluents organic matter of the other class, that is, stable organic matter. Bodies belonging to this latter group may already exist to some extent in the raw sewage, and they are the characteristic end-products of the rapid oxidation of the sewage in a trickling filter. They are not produced appreciably in the anaerobic decompositions of the septic tank, and would, therefore, appear to be the result of the direct oxidation of the organic molecule rather than of its hydrolithic cleavage.

Water analysts feel strongly the need of distinguishing between these two classes of bodies in potable waters represented by animal pollution on the one hand and by vegetable extractive matter on the other. Many attempts have been made to devise an analytical process for this purpose. Woodman (1898) has proposed a method which is worthy of wider adoption. He would determine the oxygen consumed by the regular method from permanganate and again from chromic acid.

In sewage analysis nothing in the ordinary procedure serves to give any clew to this question of the character of the organic matter. Therefore about 1895 Scudder devised as a simple method of studying this point the test which has since come to be known as the incubator test. Mr. Phelps' experience with the test upon many kinds of effluents leads him to believe that the observed changes in the amount of available oxygen and in the oxygen-consuming power of the effluent during incubation serve to indicate three different conditions of the effluents, rather than two only, and that the interpretation of the test from this point of view makes it the most valuable one in our analytical procedure. The following classification of the results of the test will make this view plain: 1, there is no loss of available oxygen during the incubation. 2, there is no loss of available oxygen. (*a*) The loss is only partial. The oxygen-consumed value is unchanged or diminished. The effluent remains clear without the production of disagreeable odor. (*b*) The loss is total. The oxygen-consumed value is increased. Putrefaction has occurred with the production of disagreeable odors, and usually of a dark sediment.

In case 1 the organic matter is stable, or non-putrescible, in the true sense of the word. Such an effluent would pass the incubation test in its strictest forms as recommended by Scudder. Case 2 (*a*) represents an effluent whose organic matter is not completely stable. The putrescibility of this organic matter is not determined by the test, since anaerobic conditions have not been established. Although the available oxygen is diminished and the effluent would not pass the test as used by Scudder, it is, nevertheless, apparent that it contains within itself the power to complete its own purification, and thus could not under any conditions become foul. Case 2 (*b*) is an example of an effluent which cannot complete its own purification, and would draw upon the purifying power of the stream. Its effect upon the stream, therefore, would depend upon other considerations, namely, relative volumes of the stream and of the effluent, character of the stream as regards previous pollution and available oxygen, etc. In general, effluents of this character ought not to be discharged. They constitute pollution even when no immediate nuisance is produced. Their effect upon the river is cumulative, and in the case of a stream receiving such effluents from a number of communities the first discharge might be of untreated sewage, while the communities lower down would be obliged to produce a very pure effluent in order to prevent fouling of the stream.

Turbidity, Color.—In effluents showing an appreciable turbidity, the determination of the total nitrogen upon the sample after filtration through paper will give additional information. Since it may be assumed that a large part of the suspended solids will eventually find its way to the bed of the stream, this information will be of practical value to the analyst. The writer has found the determination of the putrescibility upon such a filtered sample to be also of service. In some cases a mere settling out of the grosser matter will serve to change the character of the effluent from one slightly putrescible to one thoroughly satisfactory.

The color of clear effluents of high purity often serves as a useful indication of slight changes in the work of the filter. Where a high degree of purification is not attempted the color of the effluent is of no value whatever.

The odor of the effluent is often of significance to the analyst, although the difficulty of correctly describing such an odor in intelligible terms lessens the value of this test as a matter of record. The odor after incubation is obviously of great value in the interpretation of that test.

Bacteria.—When we consider that the removal of pathogenic organisms from the sewage is one of the prime reasons for its purification, it is unfortunate that the advance of knowledge in this particular subject has been very much slower than on the purely chemical and engineering sides. The actual removal of pathogenic organism from water by sand filtration has been experimentally demonstrated, and a study of the vital statistics of certain localities before and after purification of a polluted water supply leaves no room to doubt that a fairly complete removal of such organisms by sand filtration is possible.

The organisms supposed to be the cause of nitrification in the filters have been extensively investigated. Qualitative studies other than these are not very often made. What little information exists at present on this important subject is for the most part too meagre to allow of any general conclusions as to the significance of any given organisms or groups of organisms in an effluent.

Mere quantitative counts of the organisms in the effluent are of no significance except in those effluents in which a high degree of purity is expected. In such cases the number of organisms present serves as a valuable index to the amount of organic matter in the water.

Conclusion.—Summarizing briefly the most important points in the analysis of a sewage-filter effluent, it may be said that the determination of the nitrogen in all its forms is of first importance, not alone in indicating the extent of the purification, but as an index of the stability of the effluent; that the determination of the total organic carbon, or its roughly relative estimation by the oxygen-consumed test, ranks next in significance, representing material that still requires oxidation; that the dissolved oxygen is of great significance both as to the condition of the filter and the stability of the effluent; and that a study of the changes occurring during incubation serves to reinforce the analytical data, and is in reality the ultimate criterion upon which the interpretation of such data depends. The value of bacteriological data as indicative of the quality of the effluent is still an unknown quantity, although the determination of specific coefficients, as described by Clark and Gage, may eventually become the standard against which we may check our simpler laboratory methods. Such extensive studies are obviously not available in the routine work of the analyst for sewage works, but are of the greatest importance in enabling us to understand the processes with which we are dealing and correctly to interpret our analytical data.

Book Notes.

There is a lot of good advice in Dr. Harvey B. Bashore's "Sanitation of a Country House," which it would be advisable for people going into the country to read. The return of the summer excursionists to the cities in the autumn always brings a great increase in the amount of sickness, for at the present time cities are much more sanitary than country places. The limpid brook or the dear old well carries typhoid into many a family each year which seeks health and relaxation in the country or at the seashore. The meadows where the children play all day long breed mosquitoes which fill the cities with malarial patients during the next winter. Probably the reason for this carelessness is to be found in the fact that the men of the family do not, as a rule, have much opportunity to be in these summer colonies and thus become acquainted with the unsanitary conditions, while the women do not appreciate that their responsibilities as to cleanliness of surroundings are vastly increased in places where water supply and sewerage systems have not been constructed. This little book, which is not an engineering manual, but merely an untechnical collection of hints to visitors to country places, has been written by a physician who knows from his experience as an inspector for the State Board of Health of Pennsylvania, just what advice is most likely to be useful. (New York, John Wiley & Sons; cloth, $1.00.)

Although American railway location has ranged in quality from the very best to the poorest possible and has exceeded in quantity that of any other country, nevertheless very little useful information on the subject has ever appeared. The late A. M. Wellington, it is true, wrote a bulky volume which some people look upon almost as inspired, and others of equal standing consider little better than a book of sober jokes on this important subject. There have been a few papers on the general methods of railway location read before technical societies, and a few roads have issued manuals for the guidance of their field forces, but that is about all that has been done to record the great amount of valuable information American engineers have been accumulating on this very important subject. As a result there is a striking diversity of views concerning about every feature of the work, from the general organization of locating parties down to the details of camp equipment. This diversity indicates that there is considerable opportunity for improvement somewhere, for while differences of opinion on minor details must always exist, there ought to be very little difference concerning what is good and bad location. Consequently, it is gratifying to observe that in a work entitled "The Field Practice of Railway Location" Mr. Willard Beahan has stated, at much length, his opinions on everything coming within the scope of the title. If there were more books on the subject, this one would be much too diffuse in style, but this very defect ought to be of assistance in stirring up some of the equally competent locating engineers, who differ radically from this author, to write other manuals, so that in course of time the subject will be properly covered, and it will be possible for some careful student to digest the whole mass of discordant opinions critically, and let us have a real standard handbook on the subject. These comments must not be taken as meaning that Mr. Beahan's book is not a good one, for it contains a statement of the theory and practice of all features of railway location that any young engineer will find instructive. It must be borne in mind, however, that some of the topics on which the author speaks with the most positive indications of certainty are the subject of very divergent opinions among engineers of equal professional reputation in such work. (New York, Engineering News; cloth, $3.00.)

Now that gas engines and small producer gas plants are becoming so common in this country, it is natural that a demand should arise for a book concerning their installation and management. To supply this need Mr. W. B. Kaempffert has translated one of the best European manuals on the subject, that of R. E. Mathot, and the book is now available for American readers under the title "Gas Engines and Producer Gas Plants." At the present time, while many companies and private engineers are working on the producer problem where soft coal is used as the fuel, there does not seem to be a noticeable readiness on the part of any of them to claim under suitable guaranty that they have finally produced a perfect apparatus for bituminous fuel. Until that stage of development is reached, which is apparently but a matter of a short time, it is just as well that the present transition period of the art in this country is not recorded in any more permanent form than the many good trade publications with which interested readers are doubtless fully familiar. Consequently, this translation is probably as timely a work for the present needs as could be produced. The best criticism of it is in the preface, written by Dugald Clerk, the eminent

British authority, who says: "I have read this book with much interest and pleasure, and I consider that it deals effectively and fully with all the principal detail points in the installation, operation and testing of these engines. I know of no work which has gone so fully into the details of gas engine installation and up-keep." (New York, Norman W. Henley Pub. Co.; cloth, $2.50.)

The Royal Commission on Sewage Disposal has published two volumes of evidence taken at its meetings and a number of reports giving other information collected in the course of its investigation into the disposal of sewage in Great Britain. This enormous mass of printed material contains much repetition and no small amount of worthless discussion. On the other hand, there are data of high value scattered through the many pages, and it is gratifying to say that a fully competent engineer, Mr. Arthur J. Martin, has prepared an abstract of the useful portions of the reports, supplemented with notes from the documents of previous commissions and other bodies. This book, "The Sewage Problem," gives in 363 pages about all that the average engineer will find it useful to seek in these official documents. The author is interested in one of the numerous patented systems of sewage disposal in Great Britain, but he has shown complete fairness in the preparation of his abstract. His personal comments on the testimony are indicative of his own views only and this is clearly stated. The book opens with an introduction explaining the purposes of the Commission and the condition of sewage disposal in Great Britain at the time it was appointed. Afterward the author brings together the data in the various documents under the following heads: Land treatment and the unsuitability of some lands for the purpose, chemical precipitation, the principles of the bacterial processes, the need for preliminary treatment, the cultivation tank, the septic tank, the comparative value of preliminary processes, final treatment, contact beds, straining and trickling filters, filtering material, comparisons of contact beds with trickling filters, comparisons of filters with land treatment, and a number of miscellaneous collections of data and indexes. (New York, D. Van Nostrand Co.; cloth, $3.50.)

LE TURBINE A VAPORE ED A GAS. By Giuseppe Belluzzo. Milan, Ulrico Hoepli; paper, 8vo, 431 pp., 12 lire.

This is one of the best books on the steam turbine that has yet appeared. The portion on the theory of the turbine is written along the general lines of recent German treatises, but the mathematical treatment is given in more detail so that it is easily followed. The description of the various types of turbines are comprehensive and prepared with a view to explaining the distinctive features of each apparatus rather than to take the reader through each little detail of their construction. The result is that a careful reading of the book gives a good general idea of the theory and status of these prime movers, and does not leave one with a confused recollection of lofty flights in the realm of higher mathematics and of a mass of confusing tables of tests.

The first portion of the book contains seven chapters on the graphical treatment of the properties of elastic fluids and their movements. Parts of it are decidedly elementary and might be omitted were the book to be translated for American readers, but they have the advantage of making the discussion complete. The properties of both saturated and superheated steam which must be considered in steam turbine work are treated in detail, and there is a most interesting review of experimental data concerning the flow of steam and gases through orifices of different shapes. The second part of the book explains the application of the graphical method to the analysis of turbines. In this section various types of construction for utilizing steam and gas are considered and the distinctive features of each are brought out. The methods of calculating the more important parts are explained and such important topics as the influence of a high vacuum are discussed. The third part is a critical study of the important features of the De Laval, Seger, Riedler-Stumpf, Rateau, Parsons, Zoelly and Curtis machines. This study does not go into the actual details of construction, but concerns only their design as it affects the way in which they use the steam. The fourth section of the book is a discussion of the marine turbine. It should be added that the author's style is unusually clear, and that any engineer with an elementary knowledge of Italian ought to be able to read the book with little effort.

CIVIL ENGINEERING. A Text-Book for a Short Course. By Lieut.-Col. G. J. Fiebeger, U. S. A., Professor of Engineering, U. S. Military Academy. New York, John Wiley & Sons; cloth, 8vo, 587 pp., $5.

A good many engineers now holding responsible positions can recall their earliest ideas of their profession as coming from the famous treatise of Prof. Mahan, written for the cadets at the U. S. Military Academy and afterward adopted in a large number of technical schools for the introductory course outlining to freshmen the broad scope of civil engineering and the materials with which the engineer works. That treatise was revised by Prof. Wood and remained in use for an extraordinary period for a general text-book. It finally became hopelessly out-of-date, however, and several successors for its position have been written. This volume is evidently its successor at West Point, and if space permitted it would be interesting to compare the way in which the same subjects are treated in the two works. It may be said in a general way, however, that this volume is much less descriptive than the Mahan treatise, and goes much more completely into those principles of applied mechanics which every engineer uses. In fact the leading distinction between the two books is in the greater thoroughness with which Colonel Fiebeger discusses the underlying facts of civil engineering.

This is well shown by running over the order in which the subjects are taken up. The first chapter is on the classification of stresses and longitudinal stress, then come shearing and torsional stresses, flexure, beams, columns, rivets and pins, built beams, staple trusses, moving loads, graphical analysis and the stresses in bridge trusses. Over a third of the volume is devoted to these subjects, and it is not until the cadet is well drilled in the principles of applied mechanics which they involve that he passes to the subjects discussed in a more general way. These are masonry dams, retaining walls and arches, the pressure and flow of water, timber, metals, natural and artificial stone, including brick and concrete, masonry, foundations, bridges, roofs and floors, highways, water supply and sewerage.

This order and the prominence given to some of the theoretical subjects is due to the special purpose for which the book is prepared. The army officer in an isolated station often finds himself called upon to act as an engineer in charge of maintenance of various works, and sometimes must design them. His purely military duties also call for a working knowledge of some branches of engineering. Accordingly a short course in civil engineering is given at the Military Academy, which is later supplemented at the post-graduate schools with more thorough studies. The course given in Colonel Fiebeger's book is accompanied at West Point by the solution of many problems, collected in a separate book for class-room purposes. The purpose is to make the instruction thorough so far as it goes and to fix it in the memory of the cadet by the solution of numerous problems.

Letters to the Editor.

PROPERTIES OF CIRCLES.

SIR: I read with considerable interest the article of Mr. N. Spofford in your issue of July 22 in regard to determining the radius or diameter of a circle when the chord and middle ordinate are given. Is not his rule just the application of the geometrical proposition that the perpendicular dropped from the right angle of a right triangle to the hypotenuse is a mean proportional between the segments of the hypotenuse? For let $D =$ diameter of circle, $C =$ length of chord, and $O =$ length of middle ordinate, and we have immediately: $(C/2)^2 = O\,(D - O)$, $(C/2)^2 \div O = D - O$, or $D = (C/2)^2 \div O + O$, $R = \frac{1}{2} D$, which, in symbols, is his rule.

The following approximate rule for any ordinate was given me by the late Col. Wm. M. Patton: Divide the product of the segments of the chord by the diameter. This rule applied to a 10-deg. curve and 100-ft. chord introduces an error in the third decimal place in the case of the middle ordinate. Theoretically, $O = (C/2)^2 \div (D - O)$ for middle ordinate. According to the rule I have given, $O = (C/2)^2 \div 2$. Hence the magnitude of the error is apparent.

Yours truly, LOUIS O'SHAUGHNESSY.
Blacksburg, Va., July 24.

SELECTION OF WATER-WORKS PUMPING MACHINERY.

SIR: Referring to Mr. Hill's paper on the "Selection of Water-Works Pumping Machinery," builders as well as purchasers have long felt the need of a standard form of pumping engine specification, and while builders are glad to supply such specifications, yet, being interested parties, their opinions might be looked on as biased; hence this contribution of Mr. Hill's, and the paper recently read by Mr. Charles A. Hague before the American Water-Works Association, coming as they do from independent experts, should be of great value in bringing about more uniform practice in the purchase of pumping machinery.

Mr. Hill's opening remarks regarding duty, separation of contracts and confused specifications are heartily concurred in, but there are some points in his supposed specification which may be discussed, not in a spirit of criticism, but with the idea of contributing something toward the compilation of a specification which, while fully protecting the purchaser, will enable the manufacturer to turn out a "commercial pumping engine."

1. *Submission of Drawings.* It is becoming quite general practice to require the contractor to submit detail drawings of the machinery for approval before beginning the work, but the value of such practice seems at least doubtful. First, because the contractor is responsible for both the economy and durability of the engine and could not consistently be asked to submit to any alterations in the design unless relieved of responsibility for results, while in practice the purchaser in approving these drawings does not accept any responsibility for them, nor relieve the contractor of any liability.

Further than this, water-works engineers as a class are civil engineers rather than mechanical, and as such are not supposed to have as thorough a knowledge of the mechanical problems to be met as the engineers of the builder.

While the submission of drawings has not as a rule worked any hardship, yet as it has no practical effect, excepting possibly to delay the construction of the machinery, it might well in most instances be omitted.

2. *Condenser.* In describing a surface condenser it is required that it be located in the "discharge" line, while, as a matter of common practice, it is located in the suction line, and under most circumstances it is more convenient to so place it, and in addition there is much less tendency for the condenser tubes to leak when placed in the suction pipe than there would be when placed in the discharge pipe, where they would be under heavier pressure.

3. *Guarantee of Duty.* Under this heading the specification requires the duty to be guaranteed per thousand pounds of "commercially dry" steam, or, if superheated steam is used, "per thousand pounds of steam," and further states that the test shall be made so far as practical by the Am. Soc. M. E. rules. While it is quite customary to base the duty of pumping engines on steam consumption, yet to compute the duty on "commercially" dry steam would be unsatisfactory, especially as Mr. Hill does not state what constitutes "commercially dry" steam.

As a matter of fact, however, the method of computing duty even on "dry" steam, while sufficiently exact, does not afford a proper basis for comparison between different tests because of the considerable variations in steam pressure in different cases, which means different heat values for the steam, and this is further aggravated by the occasional use of superheated steam, and it was with this in view that the Am. Soc. M. E. adopted the heat unit basis for pumping engine trials, and if a standard specification is to be adopted for pumping engines it would seem preferable that the duty test should be on the B.t.u. basis.

4. *Endurance Trial.* Under this heading it is required that the engine shall be operated for fifty days at its "rated capacity," which is a very unusual requirement and one which it would be very difficult to meet in most situations, not on account of defective machinery, but because there are few situations where the water consumption is such that the engine can be run to its full capacity without wasting the water.

If a test of this kind is desired, it would seem better to require that the engine should be operated at its maximum rated capacity for a period of forty-eight hours, and in addition should be required to operate continuously for a period of thirty days on regular service, pumping such quantity of water as the service may demand, providing that it does not exceed the rated capacity of the engine at any time.

5. *Handling.* This paragraph requires that the engine may be handled without the use of "skilled labor," and the question at once arises as to what constitutes "skill" and what is considered "handling." Any of the pumping engines regularly built can be stopped and started by men of ordinary intelligence who have had sufficient experience with the machine to understand it in a general way, but the adjustment of machinery and its general "handling" should be in the hands of men possessing at least ordinary skill, and, as engine builders are usually held responsible for machinery for at least a year after it is put in operation, such a clause as suggested by Mr. Hill might, unless modified, relieve the purchaser of the machinery entirely from any responsibility due to the incompetence of his employes, a thing which would be manifestly unjust to the builder.

6. *Pressure Trials.* These require a hydrostatic test of 150 lb. per square inch, which, as Mr. Hill states in his note, would be sufficient for ordinary heads, but in many instances the regular head pumped against is greater than this; therefore, it would be better to state that the pressure test should be a certain percentage higher than the maximum working pressure, say 25 or 50 per cent.

7. *Painting.* Under this heading the interior of the pumps, etc., are to be coated with three coats of "approved paint," which is rather indefinite as to what would be "approved." Common practice requires the parts exposed to the action of water to be coated with paraffine varnish or some other of the numerous asphaltum or tar compounds.

8. *Gauges.* Under this heading four gauges are required for the engine, while for triple expansion engines more gauges than this are desired, and it would seem that this might be covered by a paragraph reading: "The engine shall be equipped with a full set of steam, receiver, vacuum and water gauges and revolution counter, all suitably mounted and connected."

Mr. Hill also requires recording steam and water gauges and mercurial thermometer for each engine, while it would seem that only one recording gauge for steam and one for water would be required for the complete station, regardless of the number of engines installed.

9. *Cast Iron.* The size of test bar suggested, viz., 1x40 in., is rather unusual, 1x2x24 in. being the usual size and one which fits the testing machines in most shops. A test bar of this size should have a transverse breaking load of not less than 2,200 lb. per square inch, with a deflection of 0.40 for metal used in the steam cylinders, pump barrels, etc., while for the metal used in other portions of the work the transverse load should be not less than 1,800 lb., with a deflection of not less than 0.35.

10. *Cast Steel.* Mr. Hill gives the minimum tensile strength at 70,000 lb. per square inch, with an elastic limit of 35,000 and an elongation of 10 per cent. in 8 in., while most specifications call for from 60,000 to 70,000 lb. tensile strength, with an elastic limit of not less than 30,000 and an elongation of 20 per cent. in 2 in.

11. *Wrought Iron.* Wrought iron is now so little used and for such small and relatively unimportant parts that it is not much of a factor in the construction of the engine, but the 52,000 lb. ultimate strength called for by Mr. Hill is much higher than the usual requirements and higher than can ordinarily be obtained. The specifications for wrought iron usually range from 45,000 to 50,000 lb., the U. S. Navy requirement being 48,000 lb.

12. *Steel Forgings.* Mr. Hill suggests that the principal forgings shall be made of "fluid compressed" steel, having a tensile strength of not less than 75,000 lb., etc. The use of such steel is objectionable, first, because it is unnecessarily expensive, and secondly, because it specifies a material in which there is no competition, there being but one forge in America and but one or two in Europe making fluid compressed steel, and it has not been demonstrated that this particular steel possesses any marked superiority.

In pumping engines where no attempt is made to limit the weight there is no necessity for the use of a special grade of material, and mild open-hearth steel having a tensile strength of from 60,000 to 70,000 lb., with an elastic limit of 50 per cent. of the tensile and elongation of 25 to 30 per cent. in 2 in., is entirely suitable for shafts and similar work, and such material can be obtained from a number of reputable forges.

It is noted that the chemical composition of the forgings, as well as their physical requirements, are stated, while some forges object to meeting both physical and chemical requirements, though willing to meet either one, their position practically being that "if the patient writes his own prescription he must not expect the doctor to guarantee the effects."

13. *Responsibility of Machinery.* This paragraph seems rather indefinite, and the following, which has been frequently used, would seem to cover the feature of responsibility more thoroughly:

"*Maintenance.* The contractor shall keep the engine in repair for one year after it is put in service, but such repairs shall extend only to making good any inherent defects in the design, materials or workmanship that may become manifest under ordinary working conditions, and shall not be held to cover any breakage or damage caused by improper use or by accidents over which the contractor has no control.

"Materials in the line of supplies, such as packing, pump valves, etc., which are ordinarily of a perishable nature, will not be considered as coming under the head of repairs.

"During the year of probation the engine will be operated by the regular employes, but no person not satisfactory to the contractor, or who is proved to be incompetent, shall have charge during the period of probation."

14. *Type of Engines.* Local conditions must be considered in selecting the type of engine most suitable for the work, and, as Mr. Hill states, the question "should be approached . . . without prejudice, . . . with the single purpose of obtaining the plant which will pump water for the least expenditure, etc." Supplying water does not differ from any other business, and the plant should be considered from the standpoint of earning capacity—keeping always in mind the absolute necessity for reliability which an indispensable public utility requires. There are many factors affecting the problem besides fuel consumption, which Mr. Hill apparently considers the only point of superiority which the vertical, triple expansion engine possesses.

Under the heading of "Vertical and Horizontal Pumps" Mr. Hill draws some comparisons as to first cost and cost of operation between horizontal and vertical engines which are not apparently warranted by any facts which have yet been made public. A table is given showing that both in first cost and cost of operation the vertical pump exceeds the horizontal, and while it is conceded that the first cost of the vertical engine is greater than that of the horizontal of similar general type, yet I think the figures for cost of operation can hardly be drawn from the average actual experience. For instance, the maintenance and repairs, labor and oil waste and supplies are all charged against the vertical pump as being greater, while, as a matter of fact, experience has shown that no type of engine has been so free from repairs or so easily maintained as the modern vertical, triple-expansion pumping engine.

For small plants where fuel is very cheap and the service irregular, there is no doubt that the direct-acting, duplex pump is, commercially speaking, the most economical, especially if built of the triple-expansion type, but for capacities above 3,000,000 gal. and up to 6,000,000 or 8,000,000 gal. (where the head is not too high) the horizontal, compound crank and flywheel engine will ordinarily be found the most advantageous, excepting, of course, where high suction lift would require the use of vertical pumps; while for capacities above 10,000,000 gal. (and, under some circumstances, above 5,000,000 gal.) the vertical, triple-expansion machine will be found not only the most economical but the most satisfactory from every point of view.

15. *Duties.* Under this heading the horizontal, compound engine is credited with a test duty of 150,000,000 ft.-lb., as against the vertical triple with 170,000,000 ft.-lb. per 1,000 lb. of dry steam. Triple-expansion engines in the larger sizes are regularly guaranteed for 170,000,000 duty, and several have reached as high as 178,000,000 on tests, while horizontal, compound engines are sel-

dom guaranteed above 135,000,000 duty, and I only know of one instance (and that a very special one) where a compound engine has reached 150,000,000 duty per 1,000 lb. of dry steam on a test.

The vertical, triple-expansion engine, aside from its economy, represents an almost ideal pump in that it has three single-acting, outside-packed plungers, which give a very steady flow of water without pulsation on the mains, making it particularly adapted for direct-service work, especially as, due to the use of three cranks, it is capable of running down to very slow speeds as well as up to the highest. For large engines it is desirable to avoid the friction and wear of heavy pistons and plungers, and this is best accomplished by making them vertical, and if we concede the desirability of the three-plunger pump, we very naturally arrive at the triple-expansion engine.

16. *Steam Pressure.* Mr. Hill states that the steam pressure has a material bearing upon the choice between compound or triple-expansion pumps, while my experience would indicate that it should have but little bearing on the choice.

Multiple expansion is employed to eliminate as far as possible cylinder condensation by reducing the range of temperature in any single cylinder; hence the higher the steam pressure the greater the necessity for increasing the number of stages of expansion, but it does not follow that there is not a corresponding gain in using triple or other multiple-expansion with comparatively low steam pressures, and the arbitrary placing of 160 lb. as the lowest limit of steam pressure advisable with triple-expansion engines is entirely unwarranted. The 160 lb. idea has descended to us from marine practice, where the conditions determining the type of engine are entirely different from those existing in water-works practice.

Table 1.—Performances of Pumping Engines, 1893-1903.

	Builder or designer.	Date of test.	Location of engine.	Type of engine.	Capacity, in gallons per 24-hr.	Piston speed, in feet.	Head.		Steam pressure, in lbs.	Indicated horse-power.	Percentage of mechanical efficiency.	Steam, i. h. p. hour.	B. t. u., i. h. p., min.	Duty, in ft.-lbs. per 1,000,000 B. t. u.	Duty, in ft.-lbs., per 1,000 lb. steam.	Percentage of thermal efficiency.
							Feet.	Pounds.								
1	Edward P. Allis Co.	1893	Milwaukee, Wis.	Vertical Triple	18,000,000	203	162.6	70.4	121	574	91	11.68	217.6	137,656,000	154,048,700	19.40
2	E. D. Leavitt	1894	Louisville, Ky.	“ Compound	16,000,000	371	193.3	83.7	137	643	93	12.15	222.5	137,565,000	148,655,000	19.07
3	E. D. Leavitt	1895	Boston, Mass.	“ Triple	20,000,000	607	137.2	59.4	176	576	89.5	*11.22	*204.3	*144,500,000	*157,843,000	20.76
4	Lake Erie Eng. Wks.	1897	Buffalo, N. Y.	“ “	30,000,000	208	199	86	167	1,186	95	12.39	231.2	135,000,000	152,000,000	18.35
5	Snow St. Pump Co.	1898	Indianapolis, Ind.	“ “	20,000,000	215	205	89	156	776	95.4	11.26	207.6	150,100,000	167,800,000	20.45
6	Edward P. Allis Co.	1899	Cleveland, Ohio	“ “	20,000,000	200	202	87.5	149	770	93.7	11.45	213	145,220,000	161,990,000	19.9
7	Nordberg Mfg. Co.	1899	Wildwood, Pa.	Quadruple Expansion	6,000,000	256	604	262	200	712	93	12.26	186	162,132,500	149,500,000	22.8
8	Edward P. Allis Co.	1899	St. Louis, Mo., No. 7.	Vertical Triple	10,000,000	175	294	127.5	136	549	94.3	11.63	216.8	143,404,000	160,455,000	18.44
9	“ “ “	1899	St. Louis, Mo., No. 8.	“ “	10,000,000	175	294	127.5	137	545	94.9	11.63	216.5	144,365,000	161,530,000	18.59
10	“ “ “	1900	Hackensack, N. J.	“ “	12,000,000	211	267	115	173	603	94	11.05	211.9	146,403,400	168,532,800	20.00
11	“ “ “	1900	St. Louis, Mo., No. 9.	“ “	15,000,000	198	293	127	127	813	96	10.78	204.4	155,237,450	176,419,600	20.78
12	“ “ “	1900	St. Louis, Mo., No. 10.	“ “	15,000,000	197	292	126	126	802	96.8	10.68	202	158,077,320	179,454,250	21.00
13	“ “ “	1900	Boston, Mass.	“ “	30,000,000	195	140	61	185	748	93.3	10.33	196	163,925,300	178,497,000	21.63
14	E. D. Leavitt	1901	Cambridge, Mass.	“ “	21,000,000	496	190	82	178	780	93.4	12.17	221	135,816,000	146,173,000	19.43
15	Holly Mfg. Co.	1901	Boston, Mass.	“ “	35,000,000	300	45	19.5	151	323	88	11.10	210	141,532,000	157,349,000	20.50
16	Holly Mfg. Co.	1901	Boston (Spot Pond).	“ “	20,000,000	248	125	54	150	464	96.5	11.01	203.4	156,592,000	173,620,000	20.85
17	E. D. Leavitt	1903	New Bedford, Mass.	Two Vertical Compound	10,000,000	480	185	80	*181	342	95	13.46	223.9	150,010,000	140,000,000	18.95
18	Edward P. Allis Co.	1903	St. Louis, Mo., No. 11.	Vertical Triple	15,000,000	197	293	126.9	138	800	97.2	10.84	204.8	155,800,000	177,300,000	20.72
19	Edward P. Allis Co.	1903	St. Louis, Mo., No. 12.	“ “	15,000,000	197	293	126.8	135	796	97.7	10.88	205.2	156,900,000	177,200,000	20.67
20	Allis-Chalmers Co.	1904	St. Louis, Mo., No. 1.	“ “	20,000,000	198	240	104	...	...	...	....	....	....	176,866,000	....

*Exclusive of auxiliaries.

High steam pressures demand multiple-expansion, but multiple-expansion is relatively economical with lower pressures down to any of the pressures ordinarily carried, and an inspection of the attached table of the performance of pumping engines will show that most of the triple-expansion engines which have given phenomenal duties have been operated with steam pressures of less than 150 lb., and indeed the engine showing the highest record, 179,454,000 ft.-lb., was operated with steam at 126 lb. pressure.

While in building a new plant I would ordinarily recommend a steam pressure at least of 150 lb. for triple-expansion engines, yet they would give practically a high economy at 125 lb., and in plants where the boilers are not capable of furnishing steam at higher than 90 or 100 lb., the triple-expansion engine is fully warranted, providing other conditions are favorable.

17. *Superheated Steam.* It is probable that a moderate amount of superheating will pay in a large plant where the apparatus can be carefully looked after and intelligently operated. Most of the tests published show the saving in pounds of steam consumed by the engine, and to this extent are misleading, as the saving on the coal pile is not necessarily proportional to the saving in steam, and it is doubtful, in the writer's opinion, whether superheating at above 100° or 150° is desirable from the point of net economy.

The saving by the use of superheated steam is dependent largely upon the type of engine in which it is used. The superheating of the steam reduces condensation in the cylinders, which is otherwise sought to be prevented by the use of steam jackets or multiple-expansion, and it is quite possible with superheated steam to obtain the same or better economy with a compound engine than is obtained with a triple-expansion engine using saturated steam. In other words, the more economical the engine is under ordinary conditions the less gain in economy it will show from the use of superheated steam, so that the gain will be greater in direct-acting pumps or compound fly-wheel engines than it will be in the higher class triple-expansion engines in which condensation is reduced by the use of multi-stage expansion.

It must not be assumed, however, that for general water works purposes a compound-engine using superheated steam is as good as a triple-expansion engine, for while it may be so if viewed solely from the point of steam economy, it is not as desirable a form of "pump," especially for the larger units, as the triple machine.

18. *Piston Speeds.* Theoretically, it may be true that "cylinder condensation is an inverse function of the piston speed," but practically, it is not true, because the piston speed can not be increased and keep "other conditions the same." High piston speed carries with it increased cylinder clearance due to the larger ports, etc., required, which fully offset the decreased condensation which would be expected from the higher speed.

An examination of the table of duties before referred to will show that the very highest economy reached (10.33 lb. of steam per i.h.p. per hour, was by an engine running at 195 ft. per minute piston speed, and it will be seen that the majority of the engines which have shown phenomenal duties are operated at about 200 ft. piston speed, with only a few exceeding 250 ft. piston speed.

A well-known firm manufacturing crank and fly-wheel pumping engines builds both the slow speed engine and the high speed engine, one type running at speeds of from 200 to 250 ft. per minute, and the other about double these speeds, and it is noticeable that in making proposals as a rule their high speed engines of the same general type are not guaranteed to perform as high a duty as their slower speed engines.

In discussing piston speed the question of revolutions must not be overlooked, as it is of more importance than the piston travel, for the wear and shock on a pumping engine is practically proportional to the number of times per minute the valves seat, or in other words to the revolutions, and specifications which limit the piston speed should also state the minimum stroke permissible.

High piston speed reduces the size of the steam cylinders, and therefore the cost of the steam end of the machine, but the pump or water end having to handle the same quantity of water in either case must be at least as large for a high speed pump as for the slow speed, and in practice the valve area required is greater for the high speed pump, so that the total cost to the purchaser is but little, if any, lower than that of the moderate speed pump.

If the high speed engine gives no better economy, and is subject to greater wear and tear, and costs practically the same as the slow speed engine, it is difficult to see any advantage in it for the purchaser.

The balance of Mr. Hill's paper on well pumps, power pumps, pumping station design, etc., calls for no special remarks, although the table of duty per 1,000 lb. of steam for different classes of pumps could, perhaps, be made a little more definite as to what is meant by "pumping engines," "large, well designed pumps," etc.

It is to be hoped that water-works managers and engineers will discuss Mr. Hill's paper at length, and it would seem as though the American Water-Works Association and the New England Water-Works Association could render valuable service to their membership by adopting a standard pumping engine specification, or at least determining the essential points to be covered in such a specification.

Irving H. Reynolds.

Youngstown, O., July 26.

Water Meters are used on half the services in Marlboro, Mass., where the consumption of water is only 46 gal. per consumer daily.

CURRENT NEWS SUPPLEMENT

AUGUST 5, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

American Society of Civil Engineers, Secretary, Chas. Warren Hunt, 220 West 57th St., New York.

American Society of Mechanical Engineers. Secretary, F. R. Hutton, 12 West 31st St., New York.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, 95 Liberty St., New York.

National Fire Protection Association. Secretary, W. H. Merrill, Jr., Chicago.

American Institute of Mining Engineers. Secretary, R. W. Raymond, 99 John St., New York.

American Institute of Architects. Secretary, Glenn Brown, Washington, D. C.

Association of Engineering Societies. Secretary Frederick Brooks, 31 Milk Street, Boston, Mass.

American Society of Heating and Ventilating Engineers. Secretary, W. M. Mackay, 235 Water St., New York.

Canadian Society of Civil Engineers. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

Society for the Promotion of Engineering Education. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

American Society for Testing Materials. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Municipal Improvements. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y. Annual meeting, Sept. 5-9, Montreal.

Association of Railway Superintendents of Bridges and Buildings. Secretary, S. F. Paterson, Concord, N. H.

American Railway Engineering and Maintenance of Way Association. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

American Water-Works Association. Secretary, J. M. Diven, Charleston, S. C.

American Foundrymen's Association. Secretary, Richard Moldenke, P. O. Box 432, New York.

Engine Builders' Association of the United States. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

American Public Works Association. Secretary, W. H. Flint, Chattanooga. Annual meeting, Chattanooga, Aug. 30-31.

Association of American Portland Cement Manufacturers. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

AMERICAN BOILER MANUFACTURERS' ASSOCIATION.

The seventeenth annual convention of the American Boiler Manufacturers' Association was held at the King Edward Hotel, Toronto, Ont., Canada, on July 25, 26 and 27. The first session was called to order by Secretary J. D. Farasey, who announced that President Robert Munroe, Jr., of the R. Munroe & Son Mfg. Co., Pittsburg, would introduce the speakers. In introducing Mr. John J. Main, of the Canadian Heine Safety Boiler Co., Chairman of Committee on Entertainment, President Munroe said that Mr. Main was the first to extend the invitation to Toronto, which they were now accepting in person. He made a brief address welcoming the members and guests to Toronto and assuring them that they would find Canadians as progressive and enterprising as those of the States. He then introduced the representative of the city, Acting Mayor John Shaw, City Controller of Toronto. He referred in enthusiastic terms to the bond of unity that binds all members of the Anglo-Saxon race, and assured his hearers that Canada rejoices in Uncle Sam's prosperity. Mr. W. H. S. Bateman, Secretary of the Associate Members' organization, made the response in behalf of the association, and proved that he had made good use of his eyes and ears since his arrival in Toronto, for he proceeded to tell the Acting Mayor many of Toronto's good points. President Munroe spoke of the improvement that has taken place in the establishment of more cordial and intimate relations between boiler manufacturers, members of the A. B. M. A., and how each had learned to esteem his neighbor at a higher value. It is highly essential that manufacturers in this line as well as others, join forces and present a united front at all times, thus being able to protect the interests of themselves as well as those dependent upon them.

Membership.—The report of the Secretary and Treasurer showed the association in healthy financial condition. As Chairman of the Membership Committee, Secretary Farasey made a report on the best mode of further increasing the membership. Mr. Kittoe urged that every member constitute himself a committee of one to bring in new men. Mr. Bateman told what work had been done by the associate members during the year, and concurred in Mr. Kittoe's suggestion. Mr. Corbett urged that an organizer be appointed on salary. Secretary Farasey thought that one of the very best ways to add to the membership would be to make the discussions and proceedings in convention so valuable that manufacturers cannot afford to stay outside. Mr. Lappan related some past experience in regard to employing an organizer, which had proved very expensive and unsatisfactory. He thought that the best thing to do would be to have an official organ and present the claims of the organization every week, believing that by repetition something would be accomplished. Matters of pending legislation could be advanced in like manner. Mr. Main told how he had received great benefit from the organization, and he believed that if he only received one single new idea each convention he attended he would get more than the worth of his time and money. This, he thought, he had done in the past. He referred to several new faces from Canada whom he was glad to see present, and he hoped the movement would spread, and many more Canadian boiler manufacturers be brought into the fold. One may work for years experimenting, but on the other hand might obtain the same result without any labor or experiment if he were to tell his troubles to another who had already had and solved a similar problem.

Col. E. D. Meier followed in a strong speech in which he reviewed the past work of the association and showed how by patient and continued effort a little had been accomplished at a time, but the sum total meant much for the progress of the boiler manufacturing industry. Granting that annual meetings were nothing more than junkets, although any reasonable man could easily be shown that they were far more than this, yet even assuming that such were the case, the benefits of meeting competitors or men with whom only a letter acquaintance had previously been had were incalculable. A man seen and known face to face becomes a living reality, and may at any time become a most useful ally and friend. The work of the association had been so gradual that sometimes its benefits were overlooked. Before the establishment of the A. B. M. A. uniform specifications, there was no uniformity in the grade of steel, and each manufacturer could furnish what purported to be a certain grade, but might greatly vary from it. The work of the A. B. M. A. had changed all this and brought about a definite standard. Again, the gradually accumulating mass of contributions to practical experience, which is comprised in the stenographic reports of discussions during past years of the A. B. M. A., is a treasure house to him who knows how to seek for and utilize it. Men who would not for a moment think of sitting down to compose carefully a written paper were yet willing to speak off-hand and tell what means they had employed in their practice to surmount a given difficulty. The results of this exchange of thought and experience are garnered in the reports of proceedings. The present great work upon which the association is engaged, through its committee, is that of unraveling the tangled skein of technicalities that has grown about the marine boiler inspection regulations and rules. Much hard labor has been given to this subject, and much more will have to be; but by patient continuance in well doing the final outcome will surely repay the effort. In this undertaking Col. Meier believed that the Committee and the A. B. M. A. would have the support and efficient co-operation of the technical press, which would be a most valuable adjunct in informing the public mind and bringing to the attention of public men this much needed reform. Col. Meier also urged the formation of local organizations or committees in all manufacturing centers, and actively proselyting for the extension of the membership. The associate members have been of great assistance, and will continue to be. Those croakers who are always asking, "What have you done at your conventions?" are the very men who have allowed others to do all that has been done, and they should, instead of croaking, come forward and put their shoulders to the wheel and bear their fair share of the burden that rests upon all who would see the boiler manufacturing industry go on to greater and still increasing usefulness and prestige.

As a result of the discussion, Mr. Corbett moved that the president appoint a committee of not less than two from each State where there are any boiler manufacturing concerns, and from the Canadian provinces, whose duty it shall be during the coming year to make every effort to extend the membership, and make regular reports to the Secretary of the success they meet with, at least once or twice a month. The motion was carried. Mr. Corbett explained that his idea was that the committees so appointed could arrange meetings to be held or conferences with boiler makers in their districts or States not members, with the design of explaining to them the aims and objects of the A. B. M. A., and enlisting their co-operation and securing their membership.

Mr. Robinson thought that it was not the matter of dues that keeps people from joining the association, but it is because they have not kept informed regarding the work that the association is doing; they need to be seen personally and interviewed and the benefits of the organization explained to them in the proper way. There are, in his opinion, many New England concerns that can be induced to join the association.

Organ and Committees.—In regard to an official organ, on motion of Col. Meier, this subject was referred to the Executive Committee to take it up with at least three technical papers or magazines, and see what arrangement could be secured if any was thought desirable.

The first business of the afternoon was the report of Auditing Committee, to the effect that the accounts of the Secretary and Treasurer had been duly examined and found correct. The report was received and filed.

The Committee on Time and Place reported unanimously in favor of Pittsburg, and their report was on motion received and adopted, and Pittsburg selected as next meeting place. The recommendation of the same committee that the dates be left for decision by the local committee was concurred in.

The report of a special committee to prepare resolutions in memory of John O'Brien, past president, was adopted. In speaking of the report Colonel Meier paid the following tribute to its subject:

"John O'Brien was, in a large sense, a representative of a type, entirely a self-made man, and well made at that; a man who began, as many of you here present have, with the riveting hammer, or perhaps even lower than that, simply as rivet boy. Those of us who have met him both in business and in social intercourse learned to appreciate him, although at first he might have seemed a pretty severe man to tackle, and we found that there was a strong manhood in him to which we could always appeal in every case. Withal, he combined a very ready wit, and I have often been struck by that in our discussions. While he said very little, he was always doing a great deal of thinking, and whenever he arose to talk he would say only a few words, but always hit the nail on the head. You might say that in his intellectual work he followed exactly the practice he had learned as a boilermaker—he struck a hearty blow, and he struck it to good purpose."

The matter of adopting some more definite standard for terms of settlement for materials was taken up, and it was agreed that the boiler manufacturers are at a disadvantage in many cases with regard to terms of settlement as compared with the rigid policy adopted by the plate manufacturers. After discussion by Messrs. Campbell, Meier, Munroe and MacKinnon, a committee was appointed, consisting of Messrs. Campbell, MacKinnon and J. Don Smith, to whom consideration of this subject was referred. This committee later reported proposed terms of settlement, which were recommended to the members generally.

Topical Discussions.—Mr. J. Don Smith, of Charleston, S. C., Chairman of Committee on Topical Subjects, reported the following for discussion: "The Adoption of a Standard Factor of Safety," "The Relative Shearing Strain of Rivets to Tensile Strength of Plates," "Proper Sizes of Blow-Off, Feed and Water Column Connections for Various Sizes of Boilers," "What is the Proper Ratio of the Grate Area to Heating Surface, Taking into Consideration the Character of Fuel, the Intensity of Draught, etc.?" "Superheaters as Applied to Return Tubular and Water Tube Boilers," "What are the Causes of Boiler Explosions?" "What are the Causes of Air Receiver Explosions?" "Laws Governing Boiler Inspection," "What are the Best Means of Increasing Our Membership?"

The first two of these questions are sufficiently answered, Col. Meier said, in the "Uniform American Boiler Specifications," edition of October, 1898.

Relative to proper sizes of blow-off, feed and water column connections for various sizes of boilers, the discussion was by Messrs. Meier, Farasey, Kittoe, Reese, Brobst, Munroe, Hegewald and Hammond, the conclusion as expressed being that the size of blow-off would vary with size of boiler, pressure carried, and quality of water, whether free from mud and scale, or the reverse, but that it is not very safe to go over 2½ in. as a maximum.

The question of the proper ratio of the grate area to heating surface elicited from Col. Meier the statement that he had been asked to report on this subject to the New England Cotton Manufacturers' Association, and found that it is possible to obtain 7-h.p. per square foot of grate with good bituminous coal; with anthracite, 5½-h.p.; with pea anthracite, about 4½-h.p.; with buckwheat, according to the quality, from 3½ to 3-h.p. For anthracite coal you have to allow from one and a half to twice the grate area as for bituminous coal.

It is well known that in New York city, in the evenings when the heavy work comes on and they think the smoke will not be seen, bituminous coal is burned by the concerns that need a great accession of power at those hours.

Col. Meier referred to the fact that during the World's Fair at St. Louis there was inaugurated under the U. S. Geological Survey a series of tests of all coals found in the United States available for steam purposes. The method adopted was to send a representative of the department to the mines, who would there select the coal to be tested, so as to avoid special coal being palmed off for test. The test was then under the direction of Prof. Breckenridge, of the University of Illinois, and when completed will prove a valuable addition to the knowledge on this subject. A further appropriation should be secured to prosecute this work, and Col. Meier requested that members use their influence with congressmen to further this experimental work by the government.

Mr. Debendarfer asked what effect using gas for fuel would have upon the area of grates. Col. Meier replied that with the style of gas burners employed for natural gas it was difficult to get as much out of a boiler as with coal. The difficulty is to get sufficient area. Unless enough area is allowed the carbon will not be consumed, and there will be black smoke. Mr. Riley said they did not pay so much attention to the grate area as to the matter of getting the proper amount of air mixed with the gas. Nine parts of air to one part gas produce the best results, so that the grate does not cut so much figure in burning gas.

The subject of superheaters was thought too general a one to be taken up and passed on in a limited time. Col. Meier remarked that the superheater was being advocated by the turbine people because it is a necessity in their business. It does not make any difference whether a water tube or horizontal tubular boiler is used, where a very high degree of steady superheating is required it is much better practice to have a separately fired superheater. Under average requirements of superheat the additional heat necessary to run a superheater is not far from ten to fifteen per cent, which, of course, has to be furnished by the fire grate. Where there are about six boilers it is necessary to furnish another entire grate, and it might as well be under a separately fired superheater where it is possible to have absolute control of it, which is not possible where it is an adjunct to the boiler and has to take its chances according to the degree of service required from the boiler at the time.

The question of the causes of boiler explosions, although a serious matter, is one that has received so much attention and is yet so far from being settled that it provoked amusement when read off. Mr. Riley suggested that he once read somewhere that one way to prevent explosions of marine boilers was to boil the water on shore. President Munroe said that some people thought a good way to do was to put no fire under the boiler. Mr. Reese contended that with a reasonable factor of safety, and sufficient water in the boiler, with safety valve in good order, there should never be a boiler explosion.

Officers.—The report of the Nominating Committee was presented and the Chairman, Mr. James Lappan, stated that the committee had used its best endeavors to secure the best material, and had instilled some young blood which they hoped would make itself felt. The report of the committee was unanimously adopted, and the following officers elected: President, R. Munroe, Jr., Pittsburg; Secretary, J. D. Farasey, Cleveland; Treasurer, Joseph F. Wangler, St. Louis; First Vice-President, M. F. Cole, Newnan, Ga.; Second Vice-President John J. Main, Toronto; Third Vice-President, John Rourke, Savannah, Ga.; Fourth Vice-President, J. Don Smith, Charleston, S. C.; Fifth Vice-President, G. H. Kittoe, Aurora, Ill.

On motion of Mr. Corbett it was decided to recommend to all members the use of the letters "A. B. M. A." on all office stationery, envelopes, letter-heads and checks, etc.

Specifications.—Col. E. D. Meier, Chairman of Committee on Uniform Boiler Specifications, submitted the report of his committee. He reviewed the history of the movement for better inspection laws from its first agitation at the very inception of the organization in 1889, and in passing referred to the effect that this and other matters attempted and carried out by the association had had in improving various conditions of the trade. Incidentally, he spoke of the efforts making to reach an understanding with the Association of American Steel Manufacturers as to uniform specifications of boiler plate. A letter was read from Secretary Albert Ladd Colby, of the latter association, regretting his inability to attend this convention in response to invitation. The discussion following was participated in by Messrs. Hartley, Hammond, Reese, Farasey, Riley, Campbell, Main and Munroe, and the report unanimously accepted and approved, and the committee continued.

The representatives of the plate manufacturers present were asked to express themselves on the matter of reduction in sulphur asked for by the A. B. M. A., and Messrs. Bentley, of the Central Iron & Steel Company, and Bateman, of the Lukens Iron & Steel Company, were put through quite a cross-examination. The mills were charged with catering to quantity rather than quality, but this imputation was resented by Messrs. Bentley and Bateman, who both declared that quality was as much desired by the plate men as by the boiler manufacturers.

Col. Meier had stated that the A. B. M. A., although having originally specified in 1898 0.025 sulphur, as there appeared to be no good reason now to prevent the boiler manufacturers and the plate men from getting together on all other requirements of shell plate subject to fire heat, the matter of phosphorus not being any longer a bone of contention under present improved processes, and other matters except sulphur seemingly in a fair way to agreement, that the boiler manufacturers would come down in their demands to 0.030 if the plate men would meet them there.

Mr. Bentley said that it is desirable that the plate manufacturers have the sulphur at 0.035, although he conceded it was not impossible to meet the .03 requirement, and that this is being found every day in instances; but if the specifications are made not exceeding 0.035 sulphur it will secure a steel suitable for their purpose. A limit set at that point will work no hardship on the mills.

Mr. Bateman took a stand against high tension steel, and challenged any boiler manufacturer present to cite a case where a difference of one one-hundredth per cent in sulphur would make any difference in the physical requirements, the working of the steel or its wear in service. As representing a steel manufacturing firm which is a member of the American Association of Steel Manufacturers he was opposed to fixing the sulphur limitation at 0.025, and thought that they should be given the privilege of 0.035 as a maximum; that while steel manufacturers might not take advantage of such a maximum, yet it would give them greater leeway. Mr. Bateman paid a high compliment to the A. B. M. A. for increasing the standard in this country of steel manufacture. The plate men never had any trouble with boiler manufacturers when they were practical men understanding the practical conditions surrounding the business.

Col. Meier stated that in his 294 tests only two went to 0.035; and the lowest in sulphur ran from 0.011 up to 0.021; the average being from 0.017 to 0.028. He asked for an explanation why the steel men could not do to-day what they did in 1897. Those tests included the product of three mills that did not use natural gas. The steel was all A. B. M. A. steel.

Mr. Bateman was asked if it was not all a question of price on the sulphur proposition, and he replied that it was not, but that the mills could not control mother earth from which they get their coal. A man who should discover a practicable process for eliminating sulphur has a fortune awaiting him. Mr. Reese contended for the low standard of sulphur and urged that if a plate cracked over the fire the loss must fall on the boiler manufacturer, and he should be allowed to judge as to what proportion of sulphur was permissible.

As a result of the discussion Col. Meier stated that he would appoint a sub-committee from his general committee on boiler specifications to confer with the American Steel Manufacturers' Association representatives on this subject of sulphur in shell plates exposed to direct action of heat or gases of combustion.

The following new members were admitted: Hodges Boiler Works, of Boston; American Engine & Boiler Works, Tonawanda, N. Y.; MacKinnon Manufacturing Company, Bay City, Mich.; Wm. Kehoe & Sons, Savannah, Ga.

The remaining sessions were executive, the convention finally adjourning Thursday noon to meet in Pittsburg next year at a date to be fixed by the local committee there.

The following resolution, submitted by Mr. Meier, was unanimously adopted at the morning session on Thursday:

Whereas, Strong and repeated protests have been made at our executive sessions against the growing practice of supply houses and mills furnishing materials and partly finished product to others than boiler manufacturers, thus encouraging and assisting them to take away work which legitimately belongs to our members; therefore, be it

Resolved, That we request the supply houses and manufacturers in general to discontinue this practice as likely to subvert the pleasant relations now existing between us.

That, as they depend on our patronage for the bulk of their business they should, instead of supplying such goods to outsiders, refer them to the shops from which they receive this patronage, and

That we would prefer to have this done under a feeling of mutual good will and not be compelled to devise repressive measures.

CONDITIONS ON THE ISTHMUS OF PANAMA

Mr. Thomas Cook, collector of revenues in the Panama Canal Zone, who has charge of the posts, lands, customs, schools and internal revenue of that territory, has recently returned North for a few weeks, and has made public the following statements concerning conditions on the Isthmus:

Contrary to the general conviction in the States, there is very little yellow fever in Panama. Of course, there always have been some cases, and other cases will appear from time to time for years. In the past year there were only 162 cases of this disease and 53 deaths in the cities of Panama, Colon and the entire canal zone, among both natives and citizens of the United States.

Governor Magoon has increased the hospital service in the Canal Zone so that accommodations can be had by 5 per cent of the 12,000 persons who are expected to arrive in Panama by June 30, 1906. This is considered by medical experts to be the maximum requirement. He has added about two hundred men to the 1,000 who were dredging the swamps in the hope of exterminating the germ-carrying mosquitoes, and 200 to those who are digging the sewers and building the water systems.

As part of the Fourth of July celebration, the water was turned on in the City of Panama. The water works are a present from the government of this country. Twelve lines of hose were attached to a 6-in. main and water thrown over a house of four stories. The first shipment of brick for paving the streets has just arrived. It is the intention of the government to clean up the cities and put them in a modern sanitary condition. The governor's actions have given the people the greatest confidence in the intentions of our country.

Within a year water systems will be established, streets will be paved, swamps will be drained and modern houses built pretty generally through the Canal Zone, but especially in Panama and Colon. Already 125 carloads of lumber have been delivered along the route of the canal for houses, and 10,000,000 feet of lumber is on the way from this country. The houses that are to be built for the government employes are to be provided with all conveniences—water, baths, screens, etc. Eating houses, where properly cooked and prepared meals may be had, are also to be erected. There will be homes for married and for single men.

We are to have mail service along the canal route. I am here now to purchase school supplies for 42 schoolhouses. There are 1,968 children of school age in the territory and many more are coming. The capacity of the schools will be 40 pupils each. There will be 25,000 American citizens in the territory eventually, and we intend to provide proper educational facilities for all their children.

We want teachers and men to take hold of the school system. I consider the pay we offer good. We give clerks $1,500 a year and homes to live in. Where quarters are not provided 15 per cent of their salaries extra is allowed for paying their board bills. This is true of all classes of employes. Bookkeepers receive from $1,600 to $2,000; stenographers, from $1,600 to $1,800; engineers, $2,000 to $2,500; chiefs of divisions, $5,000 to $9,000, and department heads, $5,000.

Any man who desires to go to Panama can send his name and list of qualifications to the Panama Commission, at Washington. He will receive free transportation south.

One of the great incentives to work given the employes of the government in responsible positions is the freedom that they have in their spheres of activity. The governor called his heads of departments together after he had appointed them, and told them that they could have full sway in their particular fields. He would give them full credit for all they did, and would require them to bear the responsibility of the failures. As a result, all have joined hands to make the general work a success.

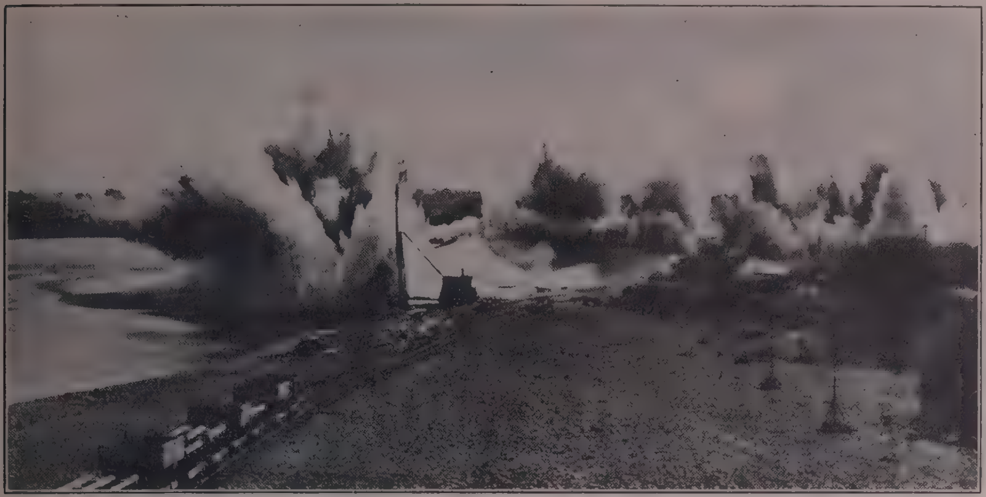
I hope that I am not painting too rosy a picture of life in Panama. I do not want to delude any young man who hopes for an easy berth. We want only men with the spirit of the pioneer. In the Canal Zone there are only work and home. There are no amusements, except the music on Sundays in the parks. The weather is hot and humid in the day, there are few tropical fruits, meals are poorly cooked and poorly served, there are no New York hotels, no Riverside Drives, no Sunday picnics. The unopen country, threaded here and there with great trails, lies all about us. In short, we do not talk of anything, dream of anything, or do anything but dig the canal.

Screening machinery has long been a specialty of the Jeffrey Mfg. Co., Columbus, O., and its catalogue of such apparatus is unusually complete. It describes cylindrical screens with single and double surfaces, octagonal screens, and special equipments for various classes of materials.

DESTRUCTION OF HENDERSON'S POINT.

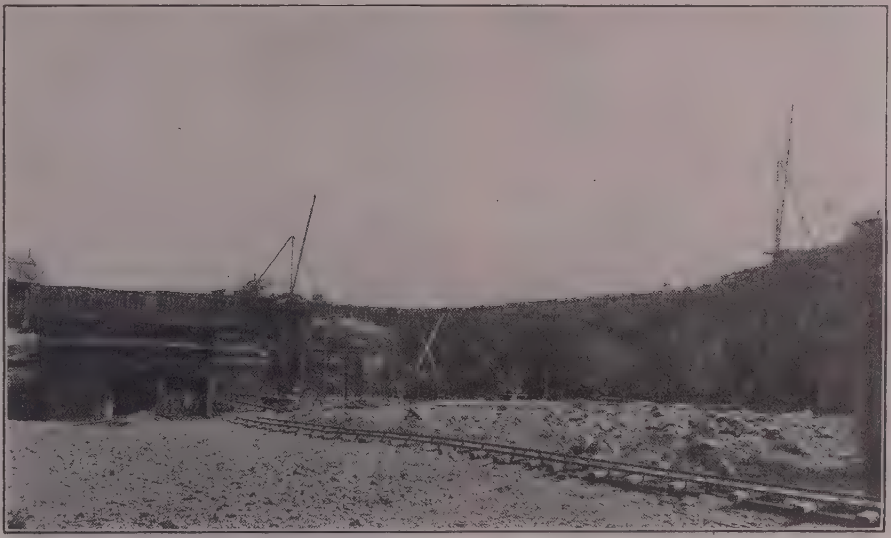
By C. B. Morse.

Certain new and distinguishing features in the field of rock excavation have gained special prominence by the destruction of Henderson's Point at the Portsmouth Navy Yard, Kittery, Me. [See Eng. Record of last week, Current News Supplement.] The removal of this rocky point was made necessary by the widening and straightening of the channel of the Piscataqua River, so that the large warships might reach the new dry-dock recently completed at Kittery. Henderson's Point projected out into the river, making a sharp turn in the swift current around which the larger ships could not pass. For the purpose of its removal, $750,000 was appropriated by the Government and the contract for the work awarded to the Massachusetts Construction Company. The inner part, or core of the point was first removed by open cut work, then, on Saturday, July 22d, the remaining "rim" was destroyed in one blast.

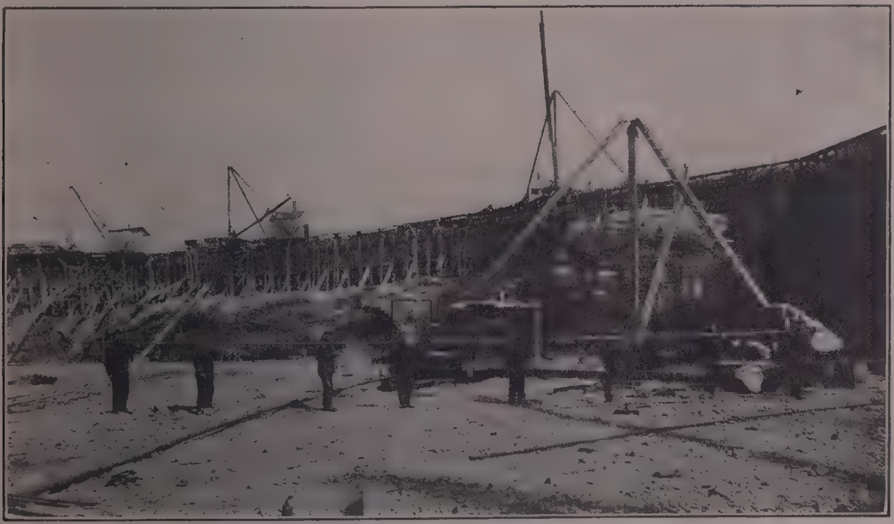


THE EXPLOSION AT HENDERSON'S POINT.

Much has been said about this explosion, which has been called by some the largest blast ever fired. As a matter of fact, the total amount of explosive used was by no means as large as that fired at Hell Gate in 1885. The Hell Gate blast extended over an area of nine acres; 270,000 cubic yards of rock were broken up, and 120 tons of "Rend-Rock" powder and 20 tons of dynamite were used. In the blast at Henderson's Point, the "rim" included approximately 25,000 cubic yards of rock and 40 tons of 75 per cent dynamite were used, or a little more than two pounds of dynamite per cubic yard of rock. This was the largest dynamite blast on record.



RIM OF ROCK AND COFFER DAM THAT WAS BLOWN UP.



ONE OF THE LONG DRILL RODS USED IN SINKING BLAST HOLES.

Had ordinary conditions prevailed the task would have been a comparatively simple one. It was the intention to begin work in the channel where the slope toward the shore began and, with the aid of a submarine drilling scow, to gradually break off the rock to the required depth until the shore line was reached. In the meantime, the centre of the Point was to be removed as in ordinary open cut work. A coffer-dam was to be built outside of the Point, the water pumped out and the "rim" removed in the open. The hitch came in getting a coffer-dam that would stay. A strong one was built, but a few days of the rushing current demolished it. The contractors then realized that this method of excavation could not be followed except at a prohibitive cost.

Bearing in mind the removal of the rock at Hell Gate, consideration was given to a proposition to drive a number of short headings from the inside of the "rim" under the outlying rock, drilling from the headings short holes for the powder. Here another obstacle was discovered in the kind of rock encountered. It was so full of seams and fissures that it was evident there would be great trouble in keeping the water from leaking through into the headings. The difficulty was finally overcome by substituting long holes from the edge of the "rim" for the headings and short holes. These holes were placed from 6 to 10 feet apart at a dip from the horizontal of 1¼ inches to the foot. In order to reach under all the rock to be removed these holes had to be drilled from 50 to 80 feet deep.

The work of excavation began with the removal of the core. The submarine drilling boat of the Eastern Dredging Company was used just below the Point, drilling holes where the shallow water began. The rock was blasted off into deep water and left there, the intention being to remove it with dredges at the completion of the work. After drilling for three months scows were substituted for the boat and the work continued for a time, about 800 cubic yards of rock being removed in all.

The failure of the coffer-dam made necessary the changes in the plans already mentioned. When the centre of the Point was removed, the work of putting in the holes began. Eight Ingersoll-Sergeant "H-9" drills were used. These drills are the largest made, having cylinders 5½ inches in diameter by 8-inch stroke. The formation of the Point was a combination of seamy trap and hard block rock. Veins of quartz were scattered through it at intervals. The drilling was very hard and irregular and required unusually frequent sharpening of steels.

The mounting of these drills was unusual, the conditions being such as to make the use of either tripods or columns impossible. The drills were bolted in a row to a heavy timber frame-work which was loaded down with stone. After a series of holes were bored, the frame-work was moved along. One of the accompanying illustrations shows seven of these drills in a line and gives an idea of the mounting. "X" bits were used for a distance of about 15 feet, after which the drilling was continued to the desired depth with a chisel bit. As already stated, these holes varied in depth from 50 to 80 feet, the final diameter being 2, 2¼ or 2½ inches, depending on the length. The holes were 5 inches in diameter at the start. The shortest time for driving one of the holes was twelve hours. In the case of others, however, it was much longer, the formation of the rock being such that the progress was very slow. Some idea of the service required of these drills can be obtained when it is remembered that the longest drill steels weighed as much as 800 pounds. One of the accompanying illustrations shows one of these steels being carried to the blacksmith shop by a gang of men.

Compressed air was the power selected for operating these drills. The power house was located about 600 feet from the Point and contained three air compressors. Two were of the duplex type with a capacity of 800 cubic feet of free air per minute each. The other was a straight-line compressor of smaller capacity. Air was supplied at 100 pounds pressure at the power house. A 4-inch main carried it to the edge of the excavation, where smaller lines took it to the drills and hoists. Of the latter there were twelve, which lifted the rock from the hole and placed it in cars. This rock was used for filling in other parts of the Navy Yard.

As the "rim" in some places was low enough to admit water at high tide, it was necessary to build a coffer-dam on top of it. The current was so strong that this was broken on several occasions, thereby flooding the excavation and compelling a temporary cessation of work. On the completion of the drilling, the holes were charged with a special 75 per cent. dynamite, supplied by the National Powder Company. This was made in sticks varying in diameter from 1½ to 4 inches. The exploders were wired up by Chief Electrician Thos. F. Flannigan, of the Navy Yard. This required great care, as it was of particular importance that the entire charge should be exploded at the same time.

To break up the coffer-dam, holes were made in it 10 feet apart and each charged with 30 pounds of dynamite. The efforts of the laborers to open a passage in the coffer-dam, so that the excavation might be filled before the explosion, did not appear successful, so that it became necessary to break a passage in the dam with dynamite. This was accomplished safely without injuring the heavy charge beneath.

A great crowd witnessed the blast, which took place at 4.10 o'clock. None of the engineers was certain as to what the result might be and there was a general fear that much damage might be done to both life and property. The water proved to be a very effectual blanket, however, although the water and debris of the cofferdam were thrown over 100 feet in the air. [The accompanying view during the explosion is published by courtesy of the Boston Globe, whose photographer was skilful enough to obtain this excellent picture.]

The task of removing the broken rock with the dredges will begin at once. The contractors report that the blast was very satisfactory in breaking up the Point and the outlying rock.

TRADE PUBLICATIONS.

The new designs of side crank, single cylinder and Corliss engines of the Ball Engine Co., Erie, Pa., are described in a well illustrated booklet. The side crank type has been adopted because it avoids the use of an overhanging wheel which, in the case of belt driving, constantly tends to wear the bearings out of line. In the Corliss engine the valve gear is so arranged that the valves open and close quickly at the proper times, but are motionless during their unbalanced period.

A "condensed talk about condensers" has been published with numerous illustrations by the Williamson Bros. Co., Aramingo Ave. and Cumberland St., Philadelphia. It takes up first the general advantages of condensing and the data required for determining the size and character of an equipment. Afterward the surface, jet, ejector, barometric tube and turbine types of condensers and the cooling tower are described. Notes are given concerning the company's evaporators, and there are some rules and tables useful in designing condensing plants.

The Gasoline Rock Drill Co., 218 South 4th St., Philadelphia, has recently brought some important improvements in its gasoline drills which are described in a supplementary bulletin to its large catalogue. This type of drill is attracting much attention, and the improvements are along the lines which extensive practical test has shown to be desirable.

The General Fireproofing Co., Youngstown, O., has prepared several folders describing herringbone expanded metal and its uses in building construction and reinforced concrete. The notes concerning the supplies necessary in applying the product will be particularly useful to contractors and to those who have to prepare specifications for its use.

The air lift is concisely described in a brochure from the Ingersoll-Sergeant Drill Co., New York. It explains the various systems of piping used in such lifts, gives some figures of the average cost of raising water with air lift under various conditions, and makes some suggestions concerning their advantages.

The National Equipment Co., Holland Building, St. Louis, Mo., has issued a folder describing the garbage incinerator designed by Mr. J. G. Branch, chief of the Department of Boiler and Elevator Inspection in that city. The designer has developed this type after considerable experience in burning bagasse and similar wet materials, and his plans provide for utilizing the heat of the fires for raising steam.

In the installation of ventilating and heating equipments it is occasionally desirable to employ some means of cleansing the air before it is delivered to the rooms. The method of doing this is probably unfamiliar to many engineers, who will accordingly find considerable useful data in a circular on the subject issued by the New York Blower Co., 25th Place and Stewart Ave., Chicago.

The Publication Bureau of the General Electric Co., Schenectady, N. Y., has lately published a number of unusually interesting pamphlets. The additions to its bulletins are as follows: No. 4404, CL-B slow and moderate-speed motors for continuous current, designed especially to secure accessibility to the armature, brush holders and field coils; 4405, starting compensators for alternating-current motors; 4406, induction motors of both the squirrel-cage and the resistance-in-armature types; 4407, field rheostats for 124, 250 and 500-volt circuits; 4408, two-wire continuous-current switchboard panels for 125, 250 and 600-volt circuits with carbon-break circuit-breakers; 4409, electrically driven turbine housepumps and their connections; 4410, type C form P circuit-breakers for continuous current circuits; 4411, the mercury arc rectifier. Recent flyers are as follows: 2150, red core wire and cable; 2151, G. E. rail bonds; 2152, concentric diffusers and adapters for use in stores and factories in connection with various types of lamps. Two special publications should also be particularly mentioned. The first is a description of the system of automatic railway block signals which the company is now making, after prolonged trial on the Pittsburg, Fort Wayne & Chicago R. R., and the second is a description of the great variety of electric locomotives built by the company for numerous classes of service.

The Herron & Bury Mfg. Co., Erie, Pa., has adopted a new system of illustrated sheets for describing the various lines of air compressors it builds. On one of the sheets there is an illustration of a portable electric-driven compressor used for operating punches, and a number of other illustrations show installations containing novel arrangements.

One of the most interesting recent applications of concrete has been made at Park 3 in Chicago, where a number of buildings designed by D. H. Burnham & Co. have been built by the Rudolph S. Blome Co. A very interesting description of this work, with excellent pictures, has been published by the Vulcanite Portland Cement Co., Philadelphia.

BUSINESS NOTES.

Orders have been received by the Westinghouse Electric & Mfg. Co. from Nelson Morris & Co. for 19 induction motors of 5 to 50 h.p. and totaling 410 h.p., and for 8 similar motors from the Decatur Car Wheel & Mfg. Co., Birmingham, Ala. On the same day an order was entered from the Illinois Steel Co. for 80 direct-current motors having an aggregate capacity of 3,920 h.p., of the railway type. The Hawaiian Electric Co., Honolulu, has contracted for two 1,200-k.w., three-phase, 2,200-volt, engine type generators, two 125-k.w. exciters and seven 500-k.w. oil-insulated, self-cooling transformers. The Rumford Falls Power Co., of Rumford Falls, Me., will install one 550-k.w. and one 800-k.w. alternating-current generator, which will be direct connected to water wheels. The order includes two 450-h.p. variable speed induction motors, and 120 transformers for use on the distributing lines.

GANG OF DRILLS AT WORK ON BLAST HOLES AT HENDERSON'S POINT.

Among the work that the Robins Conveying Belt Company, of New York, now has on hand, is the contract for additional belt conveyors for the Chicago Fast Plant of the Semet Solvay Co.; order for a mast and gaff rig and belt conveyors for the New York Contracting & Trucking Co., for use in excavating work at the Pennsylvania R. R. Station, New York, and the contract for a belt conveyor to be used by F. N. Stillman & Co., Jersey City, N. J., in connection with some large excavation work.

The Standard Metalwork Co. has been incorporated by the G. H. Bushnell Press Co., Thompsonville, Conn., for the purpose of manufacturing large pipe bends with improved joints for high pressure steam service and difficult metalwork generally, including steam superheaters, condensers, feed water heaters, as well as appliances for refrigerating, evaporating, distilling, etc., Mr. James A. Colvin, Prop., Mr. Mark Worth Bushnell, Business Director, and James Acton Miller, Mech. Engr. and Director, the latter having been engaged a number of years in this class of work.

The Board of Water Supply of the City of New York has just opened offices at 299 Broadway. Chief Engineer J. Waldo Smith desires to receive catalogs and price lists of engineering supplies.

The Brooklyn Edison Electric Illuminating Co. has contracted with the General Electric Co. for a 7,500-h.-p. Curtis turbo-generator for delivery by June, 1906.

PERSONAL NOTES.

Mr. Walter A. Doane has resigned as city engineer of Meadville, Pa.

Mr. Robert A. Shailer has been appointed consulting engineer of the Degnon Contracting Co., of New York.

Mr. C. B. Clark, assistant engineer of the Big Four system, has been appointed engineer of maintenance of way of those lines.

Major Solomon W. Roessler, corps of engineers, U. S. A., has been detailed to relieve Major William C. Langfitt, corps of engineers, U. S. A.

Mr. P. H. Palmer, borough and water engineer of Hastings, England, has been elected president of the British Association of Water-Works Engineers.

Mr. Weston Small, of Sioux City, Ia., has received an appointment as engineer in the U. S. Reclamation Service and directed to report for duty at Yuma, Ariz,

Mr. Samuel D. Brady, chief engineer of the Little Kanawha R. R. Co., has been appointed chief engineer on the brigade staff of the West Virginia National Guard.

Miss Elsie Bittman has been appointed topographical draftswoman in the Bureau of Highways, Department of Public Works, in the borough of Brooklyn of New York City.

Mr. A. S. Zinn has been promoted from the position of principal assistant engineer to that of division engineer of the Chicago, Rock Island & Pacific Ry., at Oklahoma City, Okla.

Mr. H. Fernstrom, chief engineer of the New York Central & Hudson River R. R., has resigned to become chief engineer of the Tidewater R. R., succeeding Mr. C. P. Howard, who has resigned.

Mr. Richard P. Mannix has been appointed city engineer of Anderson, Ind., succeeding Mr. J. B. Wright, who has accepted a position with the engineering department of the Illinois Central R. R.

Mr. John C. Fitterer has received an appointment as assistant engineer in the U. S. Reclamation Service and assigned to duty under Mr. M. C. Hinderlider as field assistant, with headquarters in Denver, Col.

Prof. W. E. Mott, assistant professor of hydraulic engineering in Cornell University, has resigned to become associate professor in the department of civil engineering of the Massachusetts Institute of Technology.

Mr. Chas. H. Lee, of California, has been appointed hydrographic aid in the U. S. Geological Survey and will report for duty to Mr. J. B. Lippincott, supervising engineer, U. S. Reclamation Service, Los Angeles, Cal.

Mr. P. J. Challen, assistant to the manager of the Green Fuel Economizer Co., has accepted a position with The Stirling Co., at its Philadelphia office. Mr. Challen has been connected with the Green Fuel Economizer Co. for 13 years, as designing and constructing engineer.

Mr. Frederick P. Beach, of California, who has been temporarily employed as field assistant with Mr. O. H. Ensign, electrical expert for the Pacific Coast in the U.

S. Reclamation Service, has received an appointment as mechanical engineer in the Service and will remain with Mr. Ensign.

Messrs. E. E. Beam, Harry A. Blyth, C. E. F. Ahlm, F. C. Hafemister and George Hafemister, of Cleveland, O., have become associated in the Beam Engineering Co., of that city. The company will take up electric lighting, water works, gas and street railway work and will be prepared to build, buy, sell and operate plants of that character.

Mr. B. M. McDonald has been promoted from the grade of track supervisor to that of engineer of the Pennsylvania Division of the New York Central & Hudson River R. R., at Jersey Shore, Pa. Mr. George R. Wadsworth, one of the resident engineers of the company, has resigned to become assistant to the construction manager of J. G. White & Co., New York.

Mr. G. A. Berry, bridge engineer of the New York Central & Hudson R. R., has been appointed assistant to Mr. Warren H. Knowlton, principal assistant engineer of the Electric Zone on that road, with headquarters at the Grand Central Station, New York City. Mr. C. P. Marsh succeeds Mr. Berry as bridge engineer. Mr. Charles J. Parker, principal assistant engineer, will have charge of the duties of the chief engineer on all lines exterior to the Electric Zone.

Mr. J. M. Barrett has been appointed superintendent of the New York and Jersey City terminals of the Erie R. R., succeeding Mr. W. H. Peddle, who has resigned. Mr. F. J. Moser succeeds Mr. Barrett as superintendent of the Chicago & Erie R. R., and Mr. A. Crable has been made division engineer, succeeding Mr. Moser. Mr. A. G. Trumbull, mechanical engineer of that road, has become assistant mechanical superintendent, succeeding Mr. H. B. Hunt, who has resigned. Mr. G. O. Hammond succeeds Mr. Trumbull in his present position.

The Board of Water Supply of the City of New York, which has established its offices at 299 Broadway, has officially announced the appointment of Mr. J. Waldo Smith as chief engineer, and Messrs. John R. Freeman, Frederic P. Stearns and William H. Burr as consulting engineers. Besides these gentlemen the only engineering appointment yet made is that of Mr. Alfred D. Flinn, who holds the rank of division engineer. The general scheme of the engineering staff, which has not yet been wholly approved by the municipal and state civil service commissions, is understood to provide for a chief engineer, a deputy chief engineer, six department engineers, twelve division engineers, six general inspectors, four designing engineers, an expert indexer and the necessary clerical force, besides the consulting engineers above mentioned. This organization seems to be admirably adapted to the work in hand. The Board has done nothing which will strengthen its position more before the public than its careful attention at the outset to the grave engineering responsibilities which are involved in the construction of the new water system for the city.

Mr. W. M. Probasco has resigned as assistant to the president of the McGraw Publishing Co. to become vice-president of the Search Light Publishing Co., an organization which promises to occupy an important field in the journalistic and publishing business of this country. The company owns a file of about 2,500,000 clippings, articles and pictures on all subjects, compiled from newspapers, magazines, engineering journals, books and reports of scientific societies, and has a carefully organized force by whom this information is classified and kept up to date for the use of publishers and others who require prompt and up-to-date information on any subject. In addition the company publishes a weekly paper called "The Search Light," which is a record of the most important events of the previous week and which covers some sixty separate departments. As a nucleus for this paper the company purchased "The Great Round World" and "The Week's Progress," publications somewhat on the line of its own, but has improved their plans and especially in the completeness with which the information is compiled and indexed. The company also handles the publishing and advertising accounts of important mechanical manufacturers and engineering firms, among them those of the Pennsylvania and Long Island Railroads, the Power & Mining Machinery Co. and the Morse Chain Co. The fourth department of its business is the publication of books; among those in hand is one on Cuba, and another perpetuates the exhibits of the Westinghouse Companies at the recent International Railway Congress. Mr. Probasco is well-known in electrical circles and his many friends will wish him success in this new departure. He was formerly assistant general manager of the Westinghouse Companies' publishing, advertising and exhibition interests, and in this capacity was the designer and organizer of the Westinghouse exhibits at the St. Louis Exposition, which received the grand prize as an exhibit. He was also compiler and editor of the album recently issued for the Interborough Rapid Transit Co. by the McGraw Publishing Co. Associated with Mr. Probasco in the Search Light Publishing Co. is Mr. E. G. Handy, who, with his brother, had charge of the Bureau of Publicity and Promotion at the Chicago World's Fair, and has since been a prominent newspaper man and publisher; and Mr. W. G. Jordan, who was for six years editor of "Current Literature," was later managing editor of the "Ladies' Home Journal" and subseuently editor-in-chief of the "Saturday Evening Post," of Philadelphia.

CONTRACTING NEWS

OF SPECIAL INTEREST TO CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Gadsden, Ala.—The citizens are reported to have voted July 24 to issue bonds to be used as follows: $100,000 for water works; $30,000 for sewerage, and $20,000 for street paving.

Phoenix, Ariz.—Bids recently received for the purchase of $300,000 bonds for the proposed water works have been rejected. Address Roy Goodrich, City Attorney, for bonds. It is proposed to construct a new water works system throughout. Supply will be from wells. For further information, address Omar A. Turney, Deputy City Engr.

Jonesboro, Ark.—See "Power Plants, Gas and Electricity."

Napa, Cal.—The City Council is reported to be considering the proposition of municipal ownership of the water system to supply this city. Engr. M. K. Miller is reported to have made a proposition to construct a system, the water to be obtained from wells. He will make a contract with the city of Napa that, if tests are successful, $250,000 bonds be voted at an election called for the purpose. He will then construct the entire system for the city for $250,000.

Denver, Colo.—Geo. Prince, Ch. Engr. Denver Union Water Co., writes in regard to the improvements contemplated by the company, bids for which were to have been opened July 20, that in compliance with requests from several parties who are bidding upon this work, for more time in which to prepare their proposals, this matter has been held over and the contracts have not yet been let, but will probably be executed within the next two weeks. The work will cover the construction of power machinery, electric light system, 3 filter beds, boiler house, and other improvements, to cost in all about $250,000.

Washington, D. C.—Bids will be received until Aug. 15 by the Bureau of Supplies & Accounts, Navy Dept., Washington, D. C., for furnishing at the navy yards, Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y.; League Island, Pa.; Washington, D. C.; Indian Head, Md., and Norfolk, Va, a quantity of water meters, red, fire and paving brick, Portland cement, lime, etc., iron castings, steel angles and plates, ventilating fans, bar iron and steel, generating sets, crucible steel wire, etc. H. T. B. Harris, Paymaster Gen., U. S. N.

Jacksonville, Fla.—See "Power Plants, Gas and Electricity."

Marianna, Fla.—See "Power Plants, Gas and Electricity."

Atlanta, Ga.—The City Council has adopted the resolution recently passed by the Finance Com., looking to the issue of $500,000 bonds for the improvement of the water works, but rejected the resolution providing for the right to issue $500,000 city hall bonds.

White, Hall, Ill.—It is stated that bids will be received until Aug. 18 by J. H. Piper, City Clk., for laying water mains and appurtenances in several streets.

Duquoin, Ill.—A committee is reported to have been appointed with Robt. Plumlee, Chmn., to procure specifications for water works.

Mt. Vernon, Ill.—Bids will be received at the office of John W. Alvord and Chas. B. Burdick, Engrs., 1207 Hartford Bldg., Chicago, until Aug. 15, for constructing a reservoir embankment and appurtenances for the Citizens' Gas, Electric & Htg. Co., at Mt. Vernon, as advertised in The Engineering Record.

Libertyville, Ill.—The Village Improv. Board is stated to have passed an ordinance providing for a system of water mains, to cost about $30,000.

Shawneetown, Ill.—See "Power Plants, Gas and Electricity."

Washington, Ind.—It is reported that plans are being prepared for a filter plant for the local water works, to cost about $30,000. Chas. G. Gardner, Receiver.

Indianapolis, Ind.—Bids will be received until Aug. 14 by the Dept. Pub. Wks. (M. A. Downing, Pres.), for the following work at the Brightwood Water Wks., in Indianapolis: To drill an 8-in. well to an approximate depth of 150 ft. and equip same with a 10x36-ft. deep well pump, strainer, work barrel, and other necessary equipment; also for drilling an 8-in. well to an approximate depth of 400 ft. into rock, the same to be equipped with a deep-well pump and other necessary equipment, both wells to be cased with 28-lb. line pipe; also for the repair and conversion of a steam boiler 16 ft. long and 54 ft. in diameter into serviceable use as a feed water heater.

New Castle, Ind.—The City Council is reported to have decided to construct a reservoir.

Chariton, Ia.—The Chicago, Burlington & Quincy R. R. Co. (H. C. Nutt, of Burlington, Ia., Gen. Supt. Iowa District) is reported to have purchased property west of this city, on which it is proposed to construct a reservoir.

Iola, Kan.—It is stated that bonds to the amount of $40,000 will be issued for water works construction.

Somerset, Ky.—Bids will be received until Aug. 14 by T. R. Griffin, Mayor, and the Bd. of Council for a 20-year franchise to erect, maintain and operate a system of water works.

Marksville, La.—See "Power Plants, Gas and Electricity."

Wilson, La.—See "Power Plants, Gas and Electricity."

*Peabody, Mass.—The following are the bids recently received for constructing a conduit, connecting with Suntaug Lake, Peabody; H. A. Hanscomb Co., Boston, $52,385; C. E. Trumbull & Co., $39,599; W. H. Ward, $34,617; T. H. Gill & Co., Boston, $26,523, and Rowe & Perini, South Framingham, Mass., $24,988 (awarded contract).

Uxbridge, Mass.—Bids will be received until Aug. 15 by the Water Com. (Gideon M. Aldrich, Clk.) for furnishing and laying c. i. water pipe, building a concrete-covered reservoir, 2 triplex pumps, etc., as advertised in The Engineering Record.

Boston, Mass.—See "Bridges."

Wyandotte, Mich.—The Bd. of Pub. Wks. is stated to have been ordered to prepare plans for extending the water mains to South Detroit, at a cost of $12,000.

*Manistique, Mich.—The contract for constructing water works is reported to have been awarded to Green & Sons Co., of Appleton, Wis., for $77,674.

Republic, Mich.—Bids will be received by the Township Bd. (Peter W. Pascoe, Clk.) until Aug 8 for the construction of water works, as advertised in The Engineering Record.

Hazlehurst, Miss.—See "Power Plants, Gas and Electricity."

East Grand Forks, Minn.—F. W. Cappellen, of Minneapolis, is reported to be preparing plans for water works for East Grand Forks.

Fergus Falls, Minn.—It is stated that John Adamson, employed by City Council to estimate the cost of putting in city water works paralleling the present privately owned system, has submitted his report to Council Water Works Com., in which he stated that the cost of laying mains, and incidentials, would be $67,000, and the cost of a pumping station $16,500, making a total of $83,500.

St. Martin, Minn.—Bids will be received until Aug. 12 by the Common Council for constructing an 80-ft. steel tower, supporting a 1,000 gal. wooden tank; also a main to be laid, 9 ft. deep from well to tower, with all the necessary apparatus to furnish water into tank and 1 hydrant in street. The plant is to be constructed for the purpose of fire protection. Jacob Diedrichs, Village Recorder.

Fayette, Mo.—Willard Smith, City Clk., writes that Burns & McDonnell, Dwight Bldg., Kansas City, are the engineers for the proposed water works, to cost $40,000.

*Huntley, Mont.—Robt. S. Stockton, of Huntley, Engr. U. S. Reclamation Service, writes that contracts have been awarded as follows (bids opened June 28): To W. D. Lovell, of Minneapolis, Minn., for the construction of the pumping station, concrete culvert, siphons, etc., along the line of canal east from Huntley, for $33,513; to Nick Hughes, of Butte, for construction Div. No. 1 of the canal, Huntley project, for $82,425, and to Griffiths & McDermott, of Chicago, Ill., for Divisions 2 and 3 at $35,630 and $42,570, respectively. For detail list of bids received for this work see issue of The Engineering Record July 8.

*Campbell, Neb.—Crane & Co., of Omaha, are reported to have secured the contract for constructing water works at Campbell.

Franklin, N. H.—Bids will be received by the Water Bd. on Aug. 9 for building a covered concrete reservoir of about 250,000 gal. capacity, and laying about 4,000 ft. of 8 and 12-in. water pipe, as advertised in The Engineering Record.

Mt. Holly, N. J.—The Mt. Holly Water Co. is reported to have decided to construct a stone dam 8 ft. high along upper Rancocas Creek, to cost about $8,000.

Garfield, N. J.—The citizens are reported to have voted July 25 to issue $70,000 bonds, of which $35,000 will be expended for the purchase of the plant of the Garfield Water Co., and the balance for improving the plant and extending the pipe service to Plauderville, Belmont and Robertsford.

New York, N. Y.—Bids will be received until Aug. 16 by John T. Oakley, Comr. Water Supply, Gas & Electricity, for furnishing material and building monitors on the engine houses of the 179th St. and Jerome Ave. pumping stations, and building grating platforms and stairways in the basement of the engine house of the 179th St. pumping station.

Brooklyn, N. Y.—Bids will be received until Aug. 16 by John T. Oakley, Comr. Water Supply, Gas and Electricity, N. Y. City, for furnishing and erecting an engine house for high-pressure fire service at Furman and Joralemon Sts.; also at Willoughby and St. Edwards Sts.; for furnishing and erecting the necessary steam fitting and appurtenances at the New Lots pumping station; erecting a temporary pumping plant at the new Ridgewood pumping station; a pumping engine, with all appliances complete, at the new Gravesend pumping station; 4 water tube boilers at the new Ridgewood pumping station, and 2 boilers and 1 economizer at the new Gravesend pumping station.

M. J. Dady, 350 Fulton St., is stated to have secured the contract for remodeling the pumping station at Massapequa (bids opened July 19). For detail list of bids received for this work see issue of The Engineering Record July 29.

Salamanca, N. Y.—See "Power Plants, Gas and Electricity."

Lake Placid, N. Y.—The date of opening of bids for the construction of a storage reservoir and pipe line has been extended from Aug. 3 to Aug. 14, as advertised in The Engineering Record.

Buffalo, N. Y.—The Council on July 26 approved the ordinance recently passed by the Bd. of Aldermen, referring plans for a new pumping station and intake pier, to Col. Thos. W. Symons, Gen. Geo. S. Field and Rudolph Hering, as a commission of experts.

Elizabeth City, N. C.—J. C. Ludlow, of Winston-Salem, is stated to have prepared a report on the water works

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**Items marked thus give the names of parties awarded contracts.*

**Rochester, N. Y.*—The following are the details of bids opened on July 19 for the construction of Cobb's Hill reservoir (Edwin A. Fisher, City Engr.): (*a*) Denniston & Co., Rochester (awarded contract); (*b*) W. J. Flanagan, Yonkers; (*c*) Continental Eng. Co., Buffalo; (*d*) Thos. Holahan & Co., Rochester; (*e*) Casey & Murray, Rochester; (*f*) Whitmore, Rauber & Vicinus, Rochester; (*g*) Ira M. Ludington, Oxford; (*h*) Continental Asphalt Co., New York; (*i*) Brodhead Contr. Co., Wilkesbarre, Pa.; (*j*) Henry P. Burgard, Buffalo:

	**a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*
800,000 cu. yd. earth excav	$0.17	$0.20	$0.18	$0.18	$0.17	$0.27	$0.22	$0.25	$0.25	$0.19
80,000 cu. yd. rolled emb'km't	.30	.20	.16	.18	.20	.30	.30	.18	.05	.15
40,000 cu. yd. replacing top soil	.20	.40	.50	.24	.30	.27	.30	.36	.30	.25
50,000 cu. yd. concrete mas'ry	3.59	6.25	4.64	4.90	3.75	4.95	5.75	4.55	6.00	3.75
2,700 sq. ft. concrete waterproofing	3.00	2.00	.25	1.00	1.25	4.00	1.00	3.25	1.50	1.00
7,900 sq. ft. coal tar pitch waterproofing, per square foot	2.70	5.00	4.10	4.00	3.75	4.50	4.00	4.05	4.30	3.25
2,000 sq. ft. Portland cement flag	.20	.25	.12	.12	.10	.10	.20	.18	.15	.15
67,000 lb. steel reinforcement	.02½	.07	.05	.04	.06	.05	.10	.05	.10	.03
55,000 lb. steel iron work	.06	.07	.05	.05	.07	.06	.05	.10½	.05	.05
850 tons setting pipes, special castings and valves	10.00	6.00	5.00	3.00	5.00	8.00	10.00	3.67	10.00	5.00
Totals	$390,805	$563,540	$452,455	$455,520	$396,820	$558,300	$552,150	$509,674	$572,270	$399,185

of this city, in which he recommends among other things a change of supply from Knobb's Creek to Brickhouse Point, and the installation of a filter plant.

Ft. Caswell, N. C.—Bids will be received until Aug. 15 by R. H. Williams, Quartermaster, for constructing 4 cisterns and constructing downspouts for same at this post.

Minot, N. D.—J. J. Flather, of Minneapolis, Minn., is reported to have been selected as engineer for water works at Minot.

Columbus, O.—Bids will be received by the Bd. of Pub. Service until Sept. 14 for furnishing and erecting the machinery and equipment for the Scioto River pumping station in Franklin Township, as advertised in The Engineering Record.

Delaware, O.—The Delaware Water Co. purposes erecting a new standpipe 20x100 ft., about 2 miles north of Delaware.

**Lorain, O.*—H. Y. Baxter, Pres. Bd. Pub. Service, writes that contracts have been awarded as follows (bids opened July 27): Water pipe, to the U. S. Pipe & Fdy. Co., Cleveland, $25.60 per ton; valves, to Sweet & Doyle Co., of Troy, N. Y., and fire hydrants to R. D. Wood & Co., Philadelphia, Pa.

Oxford, Pa.—Bids will be received until Aug. 8 (readvertisement), by D. H. Menough, Chmn. Water Com., for the installation of a steel standpipe, boiler, brick and concrete foundations, pumping station, complete pumping apparatus (steam or gas driven), and certain 12-in. water mains. Plans and specifications may be secured on a deposit of $10. The York Eng. Co., of York, Pa., are the engineers.

Union City, Pa.—Bids will be received until Aug. 14 by Thos. Mulvin, Secy. Boro., for furnishing material and laying water mains, etc., as advertised in The Engineering Record.

Philadelphia, Pa.—The Select Council on July 27 passed the ordinance providing for the laying of water pipe in Anderson, Atlantic, Camac, Catherine and 20 other streets.

Shamokin, Pa.—The Roaring Creek Water Co. is reported to have decided to expend about $200,000 in improvements.

Lock Haven, Pa.—Dreibelbis & Co., 548 Court St., Reading, are reported to be making surveys for the West End Water Co., of Lock Haven. This company purposes to supply water to Mill Hall, Dunnsburg, Allison, Castena, Lockport and Salona; it is also proposed to install a water power plant of 3,000-hp. capacity in the vicinity of Lock Haven; probable cost of work, $750,000.

Hanover, Pa.—Dreibelbis & Co., 548 Court St., Reading, are reported to be preparing plans for remodeling the water works at Hanover and McSherrytown.

Hartsville, S. C.—See "Power Plants, Gas and Electricity."

Charleston, S. C.—The Joint Water and Advisory Com. has selected D. M. Belcher, of Boston, Mass., to work on Goose Creek water and watch its development for the advising of the water experts, Allen Hazen, J. H. Fuertes and G. W. Fuller, all of New York.

Columbia, S. C.—Bids will be received until Sept. 1 by T. H. Gibbes, Mayor, for $400,000 water works bonds.

Parkston, S. D.—Bids will be received by F. D. Simmons, City Aud., until Aug. 8 for furnishing material and constructing water works, as advertised in The Engineering Record.

**Franklin, Tenn.*—The U. S. Cast Iron Pipe & Fdy. Co., of Chattanooga, is reported to have secured contracts for furnishing pipe at $21 per ton for large pipe and $21.50 per ton for small pipe, and 2½ cts. per lb. for specials.

Victoria, Tex.—It is reported that bids will be received until Aug. 14 by Ike Cohen, City Secy., for sinking an 8-in. artesian well approximately 1,200 ft.

Ogden, Utah.—At the meeting of City Council Aug. 25 the special Water Com., composed of Councilmen Davidson, Craig, Williams and Chambers, reported the result of their investigation on the estimated cost of constructing new water works for Ogden. They report that a new system could be constructed, with water mains throughout the entire city, with two large reservoirs with entire cement linings, at a cost of $350,000, and without the cement linings and the reservoirs, at a cost of $285,000.

**Newport News, Va.*—Saml. Hillpot, of Bound Brook, N. J., is stated to have secured the contract for constructing water works for the Peninsula Pure Water Co.; probable cost $300,000. Water will be brought here from New Market Creek. Capt. J. M. Murphy will be engineer in charge of construction.

Edmonton, Alta, Can.—Bids will be received until Aug. 15 by Comr. Pub. Wks. for an additional pumping engine. Information may be had of J. H. Hargreaves, City Engr.; C. J. Kinnaird, Secy.-Treas.

Monroe, Wis.—The City Council is reported to have under consideration the question of constructing water works.

Winnipeg, Man.—The date of opening of bids for furnishing gas engine pumping plant has been extended from Aug. 7 to Aug. 28, as advertised in The Engineering Record.

Niagara Falls, Ont.—Bids will be received by the Bd. of Water Comrs., Sept. 2, for the construction and installation of a pumping unit, as advertised in The Engineering Record.

Toronto, Ont.—Bids will be received by Thomas Urquhart (Mayor)), Chmn. Bd. of Control, until Sept. 19, for two 5,000,000 gal. turbine pumps and steam turbines; also for a supply of fire hydrants, valves and c. i. pipe, as advertised in The Engineering Record.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Gadsden, Ala.—See "Water."

Jonesboro, Ark.—See "Power Plants, Gas and Electricity."

**Washington, D. C.*—Sullivan Bros., of Philadelphia, Pa., are stated to havce secured the contract for constructing a portion of the 4½ St. high level intercepting sewer (bids opened July 24) for $39,337. For detail list of bids received for this work, see issue of the Engineering Record July 29.

St. Augustine, Fla.—The Bd. of Trade is reported to have adopted a resolution, favoring the construction of a sewerage system for St. Augustine.

**Macon, Ga.*—A. L. Patterson of Americus, is reported to have on July 25 secured the contract for constructing sewers in the annexed territory of Vineville and Huguenin Heights, for $37,500.

Brownstown, Ind.—It is stated that bids will be received until Aug. 8 for constructing two sewers. H. W. Wacker, Co. Aud.

Centreville, Ia.—Bids will be received until Aug. 11 by the City Council for constructing about 2 miles of pipe sewers reuiring approximately 6,187 8-in., 999 ft. 10-in. and 3,355 ft. 12-in. pipe, 36 manholes and 7 flush tanks; Estella Gordon, City Clk.; M. G. Hall, City Engr.

Corning, Ia.—Bids are wanted until Aug. 8 for constructing a sewer in a portion of 6th St. W. C. Chubb, City Clk.

**East St. Louis, Ill.*—The contract for sewering 21st St., in Trendley Heights, has been relet to Wolf, Maupin & Curdy, of Alton.

Marion, Ill.—It is reported that plans have been completed for a sewerage system.

Bloomington, Ill.—Bids are wanted Aug. 11 for sewers on Clinton, Bell and Center Sts. Elmer Folsom, City Engr.

Winnetka, Ill.—Bids will be received until Aug. 10 by the Bd. Local Improv. (Arthur B. Jones, Pres.) for constructing a sewage ejector station, including receiving chamber, ejector chamber, ejectors and all appurtenances belonging thereto. Approximate quantities: 6,408 ft. 8-in. vitrified sewer, 2,400 ft. 3-in. c. i. air pipe, 3,130 ft. 6-in. c. i. sewer pipe, 100 6-in. junctions, 27 manholes, 1 flusher, 1 overflow outlet, 1 by-pass, a receiving chamber, pumping plant, and ejector chamber. Total estimated cost of improvement is $14,737. Frank S. Winde, Village Engr.

**Huntington, Ind.*—Philip Hipskin & Son, of Wabash, have secured the contract for 7,180 lin. ft. of brick and concrete sewer (bids opened July 25) at $3.58 per ft. H. H. Wagoner, City Engr.

**Abilene, Kan.*—The Abilene Plumbing & Htg Co., of Abilene, is stated to have secured the contract for constructing a sewer on Buckeye Ave., for $4,178.

Covington, Ky.—The lowest bid recently received for constructing a concrete sewer, to be 7 ft. wide and 9 ft. high, inside measurement, was submitted by Lubrecht & Behle, of Covington, at the following bid: Concrete, per cu. yd., $5.90; excav., per cu. yd., 40 cts.; 12-in. pipe, per lin. ft., .60 cts.; 18-in. pipe, per lin. ft., $1.10; slants, each 50 cts.; catchbasins, each $35; manholes, each $21, and steel rods, per lb, 3¼ cts. Total cost, $12,000.

Everett, Mass.—The City Council has appropriated $25,000 for the construction of surface drainage. Work has been commenced on the system. C. Harrison, City Engr.

Jackson, Mich.—J. Harrington, City Recorder, writes that the citizens have voted to issue $20,000 sewer bonds.

St. Paul, Minn.—The Bd. of Pub. Wks. on July 24 ordered a favorable report on a sewer system, to include portions of Cretin, Grand, Finn, Lincoln and Cleveland Aves.

**Corinth, Miss.*—Bids for 7¼ miles of house sewers were opened on July 17 and contracts have ben awarded to W. M. Leftwich Co., Nashville, Tenn., for the construction, and to Southern Sewer Pipe Co., Birmingham, Ala., for pipe. Kirkpatrick & Johnson, Engrs., Jackson, Miss.

Brooklyn, N. Y.—Bids will be received until Aug. 9 (extension of date) by Martin W. Littleton, Pres. Brooklyn Borough, for furnishing material and constructing sewers in portions of several streets. Engineer's estimate 820 lin. ft. 36-in. and 270 lin. ft. 30-in reinforced concrete sewer, 3,430 lin. ft. 12-in., 415 lin. ft. 15-in., 279 ft. 18-in., and 558 lin. ft. 24-in. pipe sewer, etc.

Bids will be received until Aug. 16 by Martin W. Littleton, Boro. Pres., for furnishing materials and constructing sewers in portions of Stillwell Ave., Jefferson and 50th Sts. Engineer's estimate: 2,294 lin. ft. 18, 15 and 12-in. pipe sewer; 201 cu. yds. concrete cradle; 24 manholes; 10.5 M. ft. foundation plank; 9,500 ft. B. M. foundation plank, and transverse supports. Boro. Brooklyn.

**Rochester, N. Y.*—Contracts for constructing sewers are stated to have been awarded on July 27 as follows: on Curtis and Santee Sts., to Wm. Fuller, 16 State St., for $6,931, and on Saratoga Ave., to F. A. Brotsch & Son, 826 Clinton Ave. S, for $7,256.

Ogden, Utah.—A. F. Parker, City Engr., writes that the following are the bids opened on July 22 for the construction of sewers in Sewer Dist. No. 10: (*a*) Jas. Kennedy, Fargo, N. D., $84,193; (*b*) J. P. O'Neill, Ogden, $65,727; (*c*) Gilmartin & Zitzman, Ogden, $85,931; (*d*) Hanley & Ritchie, Topeka, Kan., $83,038, and (*e*) P. J. Moran, Salt Lake City, $70,708. J. P. O'Neill also submitted an alternate bid of $59,832 for Parmley's Patent concrete block sewer:

	a	*b*	*c*	*d*	*e*
Tile Pipe—					
36,000 lin. ft., 3-in	$0.07	$0.07	$0.08	$0.10	$0.06
765 lin. ft., 6-in	.35	.33	.36	.20	.37
24,690 lin. ft., 8-in	.54	.45	.49	.35	.40
4,560 lin. ft., 10-in	.68	.58	.72	.45	.60
760 lin. ft., 12-in	.77	.70	.87	.60	.77
1,543 lin. ft., 15-in	1.25	1.17	1.28	.90	1.09
1,543 lin. ft., 18-in	1.72	1.34	1.77	1.25	1.55
1,731 lin. ft., 21-in	2.35	1.85	2.55	1.65	2.16
3,042 lin. ft., 24-in	2.72	2.50	3.20	2.10	2.66
Brick manholes—					
5, 5 ft. diam., 13 ft. deep ea	72.00	60.00	89.00	70.00	75.00
25, 5 ft. diam., 11 ft. deep ea	67.00	55.00	75.00	64.00	65.00
19, 5 ft. diam., 9 ft. deep ea	64.00	50.00	65.00	58.00	55.00
7, 4 ft. diam., 13 ft. deep ea	67.00	45.00	82.00	56.00	70.00
22, 4 ft. diam., 11 ft. deep ea	61.00	45.00	72.00	60.00	60.00
30, 4 ft. diam., 9 ft. deep ea	59.00	40.00	60.00	55.00	50.00
25, 4 ft. diam., 7 ft. deep ea	54.00	38.00	75.00	48.00	45.00
Trench for pipe—					
765 cu yd. 6-in. pipe, 13 ft. deep	1.00	.61	.91	1.30	.80
3,800 cu. yd. 8-in. pipe, 7 ft. deep	.65	.50	.60	1.00	.50
17,250 cu. yd. 8-in. pipe, 9 ft. deep	.75	.60	.90	1.10	.70
2,140 cu. yd. 8-in. pipe, 11 ft. deep	.80	.64	.88	1.30	.75
1,500 cu. yd. 8-in. pipe, 13 ft. deep	1.00	.70	.89	1.50	.75
2,250 cu. yd. 10-in. pipe, 9 ft. deep	.80	.60	.85	1.30	.70
1,125 cu. yd. 10-in. pipe, 11 ft. deep	.90	.70	.91	1.40	.80
1,191 cu. yd. 10-in. pipe, 13 ft. deep	1.10	.80	1.05	1.60	.90
760 cu. yd. 12-in. pipe, 11 ft. wide	1.10	.70	1.00	1.50	.85
1,543 cu. yd. 15-in. pipe, 11 ft. deep	1.10	.82	1.12	1.60	.95
543 cu. yd. 18-in. pipe, 9 ft. deep	1.10	.74	.94	1.50	.80
1,000 cu. yd. 18-in. pipe, 11 ft. deep	1.30	.93	1.10	1.80	.95
1,731 cu. yd. 21-in. pipe, 11 ft. deep	1.50	.97	1.24	2.00	1.10
3,042 cu. yd. 24-in. pipe, 13 ft. deep	2.00	1.37	1.55	2.40	1.30
200 cu. yd. extra excav	2.00	.50	1.65	2.00	1.50
200 cu. yd. gravel fill	2.00	.40	1.80	2.00	1.50
25 cu. yd. extra concrete	6.00	7.00	11.00	8.00	10.00
15 M. ft. lumber left in trench	20.00	20.00	38.00	30.00	36.00

**Items marked thus give the names of parties awarded contracts.*

**Utica, N. Y.*—Besch & Beebe have secured the contract for the construction of the proposed intercepting sewer of concrete (bids opened July 21) at $170,528.

Cincinnati, O.—City Engr. Breen is stated to have submitted to the Bd. of Pub. Service an estimate stating that the proposed sewer in Duckcreek Road, from the Norfolk & Western R. R. to Dexter Ave., would cost $65,504.

Dayton, O.—The following are the bids opened July 27 for the construction of the 1st St. storm sewer: M. O. Herron & Co., $10,109; Wm. Hilt, $10,341; Phil. W. Minnigan, $11,041; David Beard, $11,912; James Reid, $11,984, and Paul & Kershner, $12,672. The detail bid of M. O. Herron & Co., of Dayton, the lowest bidders, is as follows: 4,010 lin. ft. 30-in. pipe sewer, $2.23; 1,100 lin. ft. 12-in., 45 cts.; 43 catchbasins, each $8.50, and 17 manholes, each $18. The same contractors also submitted the lowest bid, same time, for sewers in Part Dist. No. 9, for $4,506.

Dayton, O.—The following are the bids opened on July 27 for constructing sanitary sewers in Part Dist. No. 5; (*a*) M. O. Herron & Co., $24,705; (*b*) Jas. Reid, $26,331, and (*c*) Paul & Kershner, $31,258 (bidders all of Dayton):

Pipe, including Y's, etc.—	*a*	*b*	*c*
400 lin. ft. 6-in.	$0.12	$0.14	$0.12
27,560 lin ft. 8-in.	.18	.19	.20
850 lin. ft. 10-in.	.24	.27	.25
1,360 lin. ft. 12-in.	.31	.35	.30
400 lin. ft. 15-in.	.50	.45	.40
420 lin. ft. 18-in.	.65	.60	.55
Excav. and back fill—			
2,155 ft. less than 6 ft.	.20	.20	.20
21,558 ft., 6 to 8 ft.	.28	.27	.30
6,060 ft., 8 to 10 ft.	.40	.41	.50
1,200 ft., 10 to 12 ft.	.60	.57	.75
96 manholes	25.00	27.00	30.00
43 lamp holes	2.50	3.00	5.00
41 flushtanks	50.00	29.00	60.00
Repaving—			
1,320 sq. yd. brick	1.25	2.00	3.00
780 sq. yd. asphalt	2.00	3.00	3.00

Elyria, O.—The State Bd. of Health is reported to have approved and the City Council has accepted the plans of Engineers Rice & Williams for the construction of a sewerage system.

Kenton, O.—It is stated that bids will be received until Sept. 1 for constructing about 1,400 ft. of 12-in. sewer. P. K. Strong, City Engr.

Marion, O.—It is stated that bids will be received until Aug. 9 by the Bd. Pub. Service (Wm. Fies, Clk), for constructing a sanitary sewer in John St.

Middletown, O.—Bids will be received until Aug. 10 by the Bd. Pub. Service (N. G. Oglesby, Clk.) for furnishing material and constructing several sewers, as advertised in The Engineering Record.

Portsmouth, O.—The following are the bids opened July 26 by the Bd. of Pub. Service for constructing a concrete culvert 166 ft. long and 12 ft. diam. on 8th St. and Lawson St. (bidders of Portsmouth, unless otherwise mentioned): Sam'l Monroe & Son, $4,635; Kelley Bros., $4,939; Baird & Jenkins, $5,360; F. H. Sprague, $4,690; Kaps Bros., $4,786, and Strachen & Fritz, Lancaster and Zanesville, O., $4,203.

Urbana, O.—It is stated that plans have been completed for new sewer work.

Norristown, Pa.—The borough will construct, with its own men, about 4,000 ft. of intercepting sewer, 22, 24 and 27 in. diam.

Contracts will be let soon for the construction of about 14 miles of main and 15 miles of lateral sewers. S. C. Corson, Boro. Engr.

Philadelphia, Pa.—Bids will be received until Aug. 10 by A. Lincoln Acker, Dir. Dept. Pub. Wks., Bureau of Surveys, for constructing branch sewers, inlets, etc.

St. Clair, Pa.—The Boro Council is reported to have decided to construct sewers, at a cost of $8,000.

York, Pa.—The Bd. of Pub. Wks. (D. F. Stauffer, Chmn.) in its report to Council upon the progress of sewerage construction up to July 1, states that the Codorous Creek is not adequate for the purpose of carrying off the sewage of York, and recommends the construction of a purification plant in connection with the sanitary sewage system in the course of construction. It further states, that the cost of completing the interior sewers, the outfall sewer, a small pumping station with a force main leading to the disposal field and the purification works, and the practical operation of the pumping station and purification works, for a period of 3 to 5 years, will require an expenditure of about $400,000 above the present appropriation.

Hartsville, S. C.—See "Power Plants, Gas and Electricity."

Beloit, Wis.—Bids will be received by the Bd. of Pub. Wks., at the office of City Clk., on Aug. 14, for the construction of pipe sewers as follows: 448 ft. 36-in.; 240 ft. 30-in.; 3,159 ft. 24-in.; 2,490 ft. 12-in.; 225 ft. 10-in., and 2,218 ft. 8-in., with manholes, catchbasins, etc. Robt. Caldwell, City Engr.

**Manitowoc, Wis.*—Harding & Nelson, of Racine, are stated to have secured the contract for constructing about 1½ miles of sewers for $18,240.

BRIDGES.

Notes Arranged Alphabetically by States.

Napa, Cal.—It is stated that bids will be received until Aug. 15 by the Superv. for constructing a masonry bridge across creek on road between St. Helena and Calistoga. N. W. Collins, Co. Clk.

**Denver, Colo.*—T. W. Jaycox, State Engr., Denver, writes that Chas. G. Sheely, of Denver, has secured the contract for Las Animas Co. 125-ft. steel bridge and 2 abutments at Sopris, Colo., across the Purgatorie River (bids opened July 29), for $3,370.

New Haven, Conn.—Bids will be received by C. W. Kelly, City Engr., until Aug. 11 for constructing a concrete bridge 75 ft. long, 66 ft. wide and with 3 spans, over West River, on Kimberly Ave., as advertised in The Engineering Record.

**New York, N. Y.*—The following are the bids opened on Aug. 1 by Louis F. Haffen, Pres. Bronx Boro., for the extension of bridges over Port Morris Branch R. R. at Elton Ave., 162d St. and Washington Ave.: (*a*) M. J. Leahy, $23,700; (*b*) Gallo & Pettelli, $20,281; (*c*) F. V. Smith Contr. Co., $25,145; (*d*) W. J. Flannigan, $20,688; (*e*) Snare & Triest, 39 Cortlandt St., $20,263 (awarded contract):

	a	*b*	*c*	*d*	**e*
Removal and disposal of parts of old bridges (lump sum)	.....	$1,000.00	$1,000.00	$1,000.00	$1,300.00
850 cu. yd. excav.	$2.00	1.00	.60	1.00	2.00
1,200 cu. yd. fill	.....	.01	.20	.50	.10
900 cu. yd. broken range rubble mas'ry	12.00	7.00	14.00	8.00	10.50
128,500 lb. iron and steel	.04¼	.05	.045	.05	.029
250 cu. yd. Class "A" concrete	10.00	10.00	9.00	8.00	6.50
90 cu. yd. Class "B" concrete	8.00	8.00	6.00	7.00	9.00
400 sq. yd. waterproofing	1.00	.20	.70	.50	.50
50 lin. ft. new curb	.90	1.00	1.00	1.00	.90
110 lin. ft. old curb	.50	.20	.30	.25	.30
440 sq. ft. new flag	.25	.30	.25	.34	.30
560 sq. ft. old flag	.06	.05	......	.10	.15
625 sq. yd. sheet asphalt pav't	3.00	2.50	2.00	2.00	1.50
Removing, readjusting and reconnecting 12-in. water main (lump sum)	.....	600.00	500.00	250.00	100.00

**Hartford, Conn.*—The Berlin Bridge Co., of Berlin, is stated to have received the contract for constructing the bridge at Albany Ave. (bids opened July 19) for $6,490.

Boston, Mass.—Bids will be received until Aug. 7 by the Metropolitan Park Comn. (Wm. B. De Las Casas, Chmn.), for constructing the Boylston St. bridge and approaches, and masonry dam, Charles River Reservation, Newton and Wellesley; a deposit of $2 will be required for copies of plans and specifications. John R. Rablin, Engr., 14 Beacon St.

*The following are the bids opened on July 27 by Wm. Jackson, City Engr., for constructing piers and abutments for the Northern Ave. Bridge: Metropolitan Constr. Co., $178,000; W. L. Miller, $172,756; Jas. J. Coughlin Constr Co., $157,450; P. McGovern, $157,000; Holbrook, Cabot & Rollins Corp. Co., $155,000; Lawler Bros., $145,630, and W. H. Ellis, 17 Milk St., Boston, $137,790 (awarded contract).

*The following bids were opened same time and place for building the concrete and wooden flooring, roadway paving, curbing and stone coping of the Atlantic Ave. Bridge: Lawler Bros., $75,000; Wm. L. Miller, $73,671; W. H. Keyes & Co., $69,880; Globe Constr. Co., $44,786; Jas. J. Coughlin Constr. Co., $43,500, and Patk. McGovern, 6 Beacon St., Boston, $41,400 (awarded contract).

Concord, Me.—Bids will be received by the Comrs. of Somerset County until Aug. 21 for furnishing material and constructing the superstructure of a steel highway bridge across the Kennebec River between the towns of Bingham and Concord. The bridge is to be 430 ft. or more in length and to consist of 1 or 2 spans. E. E. Greenwood, C. E., Skowhegan, Me.

Portland, Me.—The Bridge Comn. is stated to have recommended awarding the contract for constructing Vaughans Bridge (bids opened July 8) to the New Jersey Bridge Co., of New York City, N. Y., at $339,555.

Grosse Point, Mich.—The citizens are stated to have voted to issue $25,000 bonds for the construction of a bridge over Connor's Creek; also one over Fox Creek.

Great Falls, Mont.—It is stated that the Great Northern R. R. Co. (A. H. Hogeland, Ch. Engr., St. Paul, Minn.), will soon let the contract for constructing a steel bridge 1,045 ft. long over Missouri River, at Great Falls.

Perth Amboy, N. J.—The following are the bids opened on July 26 by the Bd. of Chosen Freeholders of Middlesex County, at New Brunswick, for constructing three 150-ft. steel spans to the Amboy Bridge, a highway bridge over Raritan River, between Perth Amboy and the township of Sayreville: F. M. Stillman Co., Jersey City, $71,000; Penn Bridge Co., Beaver Falls, Pa., $71,000; Dover Boiler Works, Dover, $63,000; Mt. Vernon Bridge Co., Mt. Vernon, N. Y., $73,000; Berlin Constr. Co., New York, $71,800, and Sandford & Harris Co., Hoboken, $66,970.

New York, N. Y.—Bids will be received by Geo. E. Best, Comr. of Bridges, on Aug. 10, for furnishing metal work for anchorages and constructing towers, cables, suspenders and suspended superstructure of Manhattan Bridge, over East River, as advertised in The Engineering Record.

Buffalo, N. Y.—The following bids are stated to have been received by Dept. Pub. Wks. on July 20 for constructing substructure of a bridge on River St., over slip No. 1: Neil Savage, $5,500; Frank J. Reap, $6,475; Jos. F. Stabell Co., $6,500; F. W. Knickenburg, $6,600; Jas. W. Dwyer, $6,601; John Miller, $7,300: Johnson & Mumm, $8,485, and The Grattan Contr. Co., $12,511.

Ithaca, N. Y.—Bids will be received until Aug. 16 by W. O. Kerr, City Clk., for constructing traffic bridges, as follows, bids on each bridge to be submitted separately: Across Six Mile Creek at Van Natta Mills, to consist of 1 span 114 ft. c. to c., or a concrete arch 100 ft. in the clear, 18 ft. roadway, no sidewalks, and a bridge at Clinton St., to have single span 130 ft. c. to c., or 2 spans with pier, one span to be 86½ ft. c. to c. and 1 span 40½ ft. c. to c., or a 2-span concrete arch of above dimensions. Steel bridges to be riveted construction, buckle plate and concrete floor. K. P. Crandall, of Ithaca, Engr. in charge.

Troy, N. Y.—The following bids are stated to have been opened July 28 by the Bd. Contract and Supply for constructing a bridge over Wynantskill River, at Winter St.; A. A. Parker, $7,800; J. H. Gleason, $6,699; Frank Pidgeon, $8,276; Mahony Constr. Co., $7,900; United Constr. Co., Albany, $6,846; Rochester Bridge Co., $4,789; New Jersey Bridge Co., $5,475; Canton Constr. Co., Albany, $6,189; L. F. Shumaker, New Haven, $6,375.

Bowling Green, O.—Bids will be received until Aug. 21 by the Bd. Co. Comrs. for furnishing materials and constructing a bridge over Portage River in Freedom Township; entire length of bridge to be 140 ft. with a 16-ft. roadway and a single track; B. C. Harding, Co. Aud.

Chillicothe, O.—Bids will be received until Aug. 21 by the Bd. Co. Comrs. for furnishing structural steel and all other necessary material for repairing a double-track roadway, covered-arch truss, highway bridge of 212 ft. extreme span over Main Point Creek, 2 miles east of Bainbridge. Chas. H. Pinto, Co. Aud.

**Eaton, O.*—The contract for constructing a 150-ft. span bridge over Seven Mile Creek, in Gasper Township, is stated to have been awarded to the Indiana Bridge Co., of Muncie, Ind., for $6,663.

Ironton, O.—E. Fisher, Johnson Bldg., Ironton, Ch. Engr. Ashland & Ironton Bridge Co., writes that bids will be opened on Aug. 12 for the proposed bridge over Ohio River, connecting Ashland and Ironton, of which note was made in our issue of July 29. The proposed substructure and concrete piers will cost about $125,000.

Salem, Ore.—The City Council is stated to have passed an ordinance providing for the issue of $35,000 bonds for the construction of concrete bridges throughout the city.

Hazelwood, Pa.—It is stated that Jones & Loughlin Steel Co. and the Baltimore & Ohio R. R. Co. (D. D. Carothers, Ch. Engr.) are considering constructing a steel bridge over Monongahela River, near Hazlewood, at a cost of about $200,000.

Lockhaven, Pa.—Press reports state that bids will be received until Aug. 9 by the Bd. Co. Comrs. for constructing a steel bridge, to be 80 ft. long and have a 14-ft. roadway, over Fishing Creek, in Porter Township.

San Juan, Porto Rico.—Bids will be received until Sept. 30 by the Bureau of Pub. Wks. of the Dept. of the Interior, at the office of J. J. Jiminez, Supt. Pub. Wks., alternate bids, plans and specifications for furnishing and erecting or for furnishing only, on the dock at San Juan, a steel-riveted, lenticular or double bowstring, through-truss, highway bridges, 100 ft. span; also on same date alternate bids, plans and specifications for furnishing and erecting or for furnishing only, on the dock at San Juan, a steel-riveted, through-truss highway bridge, 266-ft. span.

Nashville, Tenn.—The Bridge Com. is reported to have under consideration the selection of a site for a bridge across Cumberland River, in this city; appropriation, $300,000.

Cameron, Tex.—The suspension bridge at Faubions Crossing, over Little River, is reported destroyed. According to reports a new bridge will be constructed.

Marlin, Tex.—The citizens of Falls County are reported to have voted to issue bonds to construct 2 wagon bridges over Brazos River. Address County Judge.

Charleston, W. Va.—The following bids are reported to have been received July 20 for constructing a truss bridge over Elk River: Canton Bridge Co., $58,500; King Bridge Co. (5 bids), $42,000 to $60,000; Virginia Bridge & Iron Co. (2 bids), $60,000 and $59,300; West Virginia Bridge & Constr. Co. (18 bids, the company bidding on various portions), $19,471 to $57,800; Owego Bridge Co. (5 bids), $51,450 to $68,950; Nelson & Buchanan Co. (5 bids), $44,134 to $76,345; Joliet Bridge & Iron Co. (3 bids), $63,000 to $78,500; New Jersey Bridge Co. (2 bids), $43,775 and $48,475, and the Penn Bridge Co. (4 bids), $34,000 to $56,000.

Huntington, W. Va.—It is stated that bids will be received until Aug. 21 by the Co. Comrs. for constructing a bridge across Guyandotte River, between Guyandotte and Huntington. The bridge is to consist of three spans 100 ft., 220 ft. and 140 ft., and 122 ft. of steel trestle, with necessary substructure.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Gadsden, Ala.—See "Water."

San Francisco, Cal.—It is stated that $12,000 will be expended on constructing an approach to the 3d St. Bridge, over Channel St.

Thomaston, Conn.—Bids will be received until Aug. 7 by the Bd. Selectmen (Geo. P. Bradstreet, 1st Selectman), for grading and constructing 2 sections of road.

**Bridgeport, Conn.*—E. T. Buckingham, City Clk., writes that the contract for laying 13,000 sq. yds. paving (bids opened July 17) has been awarded to the Standish Stone Corporation, of Bridgeport, at $2.70 per sq. yd. Mack repressed block will be used.

**Waterbury, Conn.*—R. A. Cairns, City Engr., writes that the contract for paving Grand and N. Willow Sts. with bitulithic (bids opened July 18) has been awarded to Warren Bros. Co., of Boston, Mass., for about $15,000.

Seymour, Conn.—Bids will be received until Aug. 12 by the Bd. Selectmen (Geo. A. Divine, Chmn.) for constructing a section of gravel road in this town.

Washington, D. C.—See "Water."

Washington, D. C.—See "Miscellaneous."

Rock Island, Ill.—Bids are wanted Aug. 11 for paving 21st St. with asphalt; probable cost, $8,000. W. Treichler, City Engr.

Edwardsville, Ill.—It is stated that about $100,000 will be expended on street improvements in Edwardsville.

**Petersburg, Ill.*—Jesse M. Ott, Mayor, writes that the contract for 8,670 sq. yd. brick paving (bids opened Aug. 1) has been awarded to John Cherry, of Jacksonville, for $15,600.

Chicago, Ill.—Jas. A. Sackley & Co., Chamber of Commerce Bldg., has secured the contract for paving Vincennes Road, 95th St., Leyden Ave. and other streets

**Items marked thus give the names of parties awarded contracts.*

(bids opened July 27 by the Bd. of Pub. Wks.) for about $38,000.

Bloomington, Ill.—Bids are wanted Aug. 11 for paving Seminary Ave., Vale, Olive, Oak and Lee Sts., with brick, 16,000 sq. yds. Elmer Folsom, City Engr.

Freeport, Ill.—The Bd. of Local Improv. has adopted a resolution for paving certain alleys with brick, at an estimated cost of $6,000.

**Lincoln, Ill.*—Jas. C. Greenslate, City Clk., writes that C. D. Frey & Co., of New Castle, Ind., have secured the contract for paving with Culver block (bids opened July 25) as follows: College Ave., $1.82 per sq. yd.; Pekin St., $1.73, and Logan St., $1.80, and for excav., 25 cts. per cu. yd., and concrete curb and gutter 55 cts per lin ft.

**Springfield, Ill.*—The Barber Asphalt Paving Co. has secured the contract for paving W. Grand Ave., from Washington St. to Williams Boule., 7 blocks, with asphalt, at $1.78 per sq. yd. for paving and 55 cts. per lin. ft. for combined curb and gutter.

Chicago, Ill.—Bids will be received until Aug. 9 by the Bd. Local Improvements (And. M. Lynch, Pres.) for constructing cement sidewalks on portions of numerous streets.

Michigan City, Ind.—The Bd. of Pub. Wks. has passed a resolution providing for the paving of 9th and Oak Sts. with brick.

Greencastle, Ind.—It is reported that bids will be received by the Co. Comrs. until Aug. 12 for constructing about 16,000 ft. of macadamized roads. C. C. Hurst, Co. Aud.

Sullivan, Ind.—It is reported that bids will be received by the Co. Comrs. until Aug. 10 for constructing about 16,000 ft. of gravel or macadmized roads. E. E. Russell, Co. Aud.

Manchester, Ia.—It is stated that bids will be received until Aug. 8 by Ennis Boggs, City Clk., for paving with vitrified brick or block on Franklin and Main Sts.

Ottumwa, Ia.—C. R. Allen, City Engr., writes that bids will be received until Aug. 7 for 3,000 sq. yds. brick paving on Washington St.

Atchison, Kan.—Fred. Giddings, City Engr., writes that bids will be received on Aug. 7 at the office of City Clk., for paving Mound St., to consist of 8,300 cu. yds. grading, 3,200 lin. ft. curb and 5,380 sq. yds. of 2-course brick or 1-course brick on 6-in. macadam.

Hagerstown, Md.—It is reported that bids will be received until Aug. 8 by the Co. Comrs. (John E. Wagaman, Clk.), for grading and macadamizing about 1½ miles of road between Hancock and Mason and Dixon's line.

Centreville, Md.—Bids will be received by the Co. Comrs. at Centreville (Jos. M. Parvis, Clk.), until Aug. 8, for grading and macadamizing about 3 miles of road between Centreville and Chestertown.

Towson, Md.—Bids will be received by the Highway Comrs. of Baltimore County on Aug. 17 for grading and macadamizing highway bet. Rogers Ave. and Cockey's Tavern, about 1.2 miles in length; also same date for grading and macadamizing about 1¼ miles of highway bet. the property of Mr. Riggs and Mr. Geo. Jenkins' entrance, both proposals advertised in The Engineering Record.

Rockville, Md.—Bids will be received until Aug. 8 by the Co. Comrs. (Robt. G. Hilton, Clk.), for grading and macadamizing about 1 mile of road between Sellman and Poolesville.

**Clarksburg, Mass.*—J. W. Polcaro, Pittsfield, is stated to have secured the contract for constructing a section of State Highway in Clarksburg (Bids opened July 27), for $4,696.

Fairview (Wayne Co.), Mich.—The Village Council is stated to have awarded the contract for paving with brick on Jefferson Ave., to the Cleveland Trinidad Paving Co., of Cleveland, O., for $217,013.

**Detroit, Mich.*—The Cleveland Trinidad Paving Co., of Cleveland, O., is stated to have received the contract for repaving Canfield Ave., at $12,247.

Iron Mountain, Mich.—The proposition of bonding the city for $50,000 for street improvements is reported under consideration.

Concord, N. H.—Bids will be received until Aug. 9 by A. W. Dean, State Engr., for improving roads in several towns, by paving with gravel and macadam.

**Flemington, N. J.*—The Hunterdon County Bd. of Freeholders is stated to have awarded the contract for macadamizing a road between Ringoes and Lambertville, a distance of about 6 miles, to Delaware River Quarry & Constr. Co., of Lambertville, for $47,900.

Jersey City, N. J.—Bids will be received until Aug. 7 by the Bd. Street & Water Comrs. (Geo. T. Bouton, Clk.), for improving a portion of Williams Ave., requiring 4,710 sq. yds. pavement; a portion of Ege Ave., 3,594 sq. yds. pavement; Lexington Ave., 3,050 sq. yds. pavement, and Yale Ave., 3,384 sq. yds.; material in all cases to be asphalt.

New York, N. Y.—Bids will be received until Aug. 10 by the Park Bd. (John J. Pallas, Pres.) for furnishing and setting curbstones and paving with granite block a portion of W. 96th St.; also for paving with asphalt certain of the walks around the menagerie building, Central Park; furnishing and delivering asphalt paving blocks where required on Central Park; furnishing and delivering coarse North River Road gravel for drives in Central and Riverside Parks, all in Boro. Manhattan.

Elizabeth, N. J.—The only bid received and opened on Aug. 1 for paving Jefferson St. was submitted by the Barber Asphalt Co., at a total of $23,822. It bid for 6,398 sq. yd. asphalt paving on depressed block, $2.11; 556 sq. yd. asphalt paving, 3½ in. deep, no foundation, $1.70; 508 sq. yd. concrete, 6 in. thick, 80 cts.; 3,876 sq. yd. block pavement, relaid on concrete and use tar and gravel filler, $1.50; 4,994 lin. ft. concrete, 1 in. wide, 9½ in. deep, 20 cts.; 270 lin. ft. headers set in concrete, 65 cts.; 4,390 lin. ft. curb reset, 8 cts.; 400 lin. ft. new curb, 48 cts., and 127,900 old paving block redressed, $10 per M. The same company also bid for paving Anna St. with asphalt from Jefferson Ave. to Walnut St., 1,765 sq. yd., at $2.47, with incidental bridge work; total cost, $4,613.

Several streets between Jefferson Ave. and Madison St. have been ordered paved with asphalt. W. H. Luster, Jr., City Surveyor.

Brooklyn, N. Y.—Bids will be received until Aug. 16 by Martin W. Littleton, Boro. Pres., for regulating, grading, curbing, paving and laying sidewalks on portions of 15 streets. Engineer's estimate: 32,850 sq. yd. asphalt block, 2,483 sq. yd. granite block; 25,521 lin. ft. new curb, furnished and set in concrete; 100,442 sq. ft. cement sidewalks, 4,280 cu. yd. concrete, 45,270 sq. ft. cement concrete walk, 32,050 cu. yd. earth excav., etc.

Newburg, N. Y.—Bids will be received until Aug. 15 by the Bd. Pub. Wks. for furnishing material and laying about 8,100 sq. yd. on a portion of Lander St., including the building of catch basins, setting curb stones, etc. Everett Garrison, City Engr.

**Rensselaer, N. Y.*—Michael F. Dollard, 86 State St., of Albany, is stated to have received the contracts (bids opened July 18) for paving Catharine St. and B'way, at $3,964 and $6,162 respectively.

**Rochester, N. Y.*—The Bd. of Contract is stated to have awarded contracts as follows: Chambers & Grady, with brick, Terry St., $3,049, and Shelter St., $15,741; H. N. Cowles, 47 Tacoma St., with brick, on Ravine Ave., $29,207.

Greensboro, N. C.—Bids will be received until Aug. 17 by the Mayor and Bd. of Aldermen for furnishing material and grading and paving about 19,000 sq. yd. on Elm St. with either vitrified brick, asphalt or bitulithic, as advertised in The Engineering Record.

Gaston, N. C.—Bids will be received until Aug. 17 by the Bd. Co. Comrs. for $300,000 public road improvement bonds; for further information address A. J. Smith, Clk.

**Findlay, O.*—John A. Sutton, Co. Aud., writes that the contract for constructing 4 miles stone pike in Orange Township (bids opened July 26) has been awarded to Patterson Bros. & Co., of Ada, for $11,020.

Madisonville, O.—Bids will be received until Aug. 23 (extension of date) by J. A. Conant, Village Clerk, for furnishing materials and repairing and resurfacing improved streets. Estimated quantities: Stone, 2,579 cu. yds.; fine crushed stone or screenings, 750 cu. yds.; sprinkling and rolling, 36,000 sq. yds.

Norwalk, O.—It is reported that bids will be received until Sept. 5 by the Bd. Pub. Service (E. O. Friend, Pres.) for furnishing material, grading, curbing and paving a portion of South Garden St.

Alliance, O.—It is stated that bids will be received until Aug. 22 by the Bd. Pub. Service (C. E. Harsh, Clk.) for grading, curbing and paving on S. Union Ave., W. Cambridge and Summit Sts. and Haines and Gyger Aves., in all about 55,000 sq. yd.

Marion, O.—It is stated that bids will be received until Aug. 9 by th eBd. Pub. Service (Wm. Fies, Clk.), for furnishing material and paving with asphalt on a portion of Windsor St.

Mansfield, O.—The following are the bids opened on July 27 for paving Mulberry St. with brick, 10,800 sq. yds.: Heffner & Fishbaugh, Celina, 95 cts. and 99 cts. per sq. yd., according to class of block; F. Gandert & Son, Mansfield, 99½ cts and $1; Geo. B. Herring & Son, Mansfield, $1 and $1.01; Ohio Eng. Co., Elyria, 89 cts., 91 cts and 93 cts. The Barber Asphalt Co. submitted a bid of $1.31½ per sq. yd. for asphalt and the Warren Bros., of Boston, Mass., bid $1.85 per sq. yd. for paving with bitulithic.

The following are the bids opened, same time and place, for constructing concrete culvert on E. 3d St.: Roland & Mohler, Mansfield, $5,840; T. W. Hill, Bellefontaine, $4,214; F. F. Schufeer & Son, Mansfield, $4,885; Wm. C. McHugh, Springfield, $6,850, and Ohio Eng. Co., Elyria, O., $3,372.

Cincinnati, O.—The lowest bid opened on July 27 for grading, curbing and paving 2d St. with granite was submitted by T. F. McClure Sons Co., Perin Bldg., for $100,210.

**Dorranceton, Pa.*—The Borough Council is stated to have awarded the contract for furnishing 275,000 brick for paving at $24.20 per M. to the Mack Mfg. Co., Land Title Bldg., Philadelphia, this being the borough's portion of the improvement.

**Allegheny, Pa.*—The Bd. of Pub. Wks. is stated to have awarded contracts for grading and paving of streets necessary for the raising of streets at North Ave., over Pittsburg, Ft. Wayne & Chicago R. R. tracks, as follows: International Constr. Co., of Bessemer Bldg., Pittsburg, Fairview Ave., $3,273; Marshall Ave., $11,955; Marion Ave., $10,469; Ohio St., $7,760; Irwin Ave., $9,665, and Western Ave., $15,330; A. V. Purnell, Federal St., with Ligonier block, $6,183.

Media, Pa.—Bids will be received until Aug. 12 by the State Highway Dept., Harrisburg (Jos. W. Hunter, Comr.) for reconstructing a road in Tinicum Township, in all about 16,200 ft.; also for reconstructing road in Concord Township, in all about 7,647 ft.

New York, N. Y.—The following are the bids opened on Aug. 1 by Louis F. Haffen, Pres. Bronx Boro., for regulating, grading, setting curbs, flagging, sidewalks, building approaches, etc., in Creston Ave., from E. 184th St. to Minerva Pl.: (*a*) W. J. Flannigan, $33,779; (*b*) Troy Public Works Co., $30,845; (*c*) J. C. Voorhies, $29,526; (*d*) G. I. Bailey, $27,002; (*e*) D. W. Moran, $28,066; (*f*) Waldo Asphalt Paving Co., $27,256.

	a	*b*	*c*	*d*	*e*	*f*
7,550 cu. yds. earth excav.	$0.50	$0.60	$0.40	$0.72	$1.00	$0.50
2,350 cu. yds. rock excav.	1.75	1.50	1.50	1.50	1.00	1.50
15,700 cu. yds. fill	.32	.30	.40	.06	..	.19
8,850 lin. ft. new curb	.85	.80	.75	.80	.82	.75
100 lin. ft. old curb	.15	.50	.10	.15	.12	.20
32,400 sq. ft. new flag	.32	.25	.24	.25	.27½	.26
3,500 sq. ft. old flag	.10	.10	.06	.02	.03	.02
3,000 sq. ft. new bridge stone	.75	.65	.60	.50	.51½	.50
160 cu. yds. dry rubble masonry	2.00	3.00	1.50	2.00	2.00	1.75
280 sq. ft. old bridge stone	.15	.25	.10	.05	.06	.15

Ingram, Pa.—Bids will be received until Aug. 7 by the Boro. Council for constructing a sewer 200 ft. long, and the grading, curbing and paving of McKee and Short Sts. L. H. Dougherty, Boro. Engr.

Bellevue, Pa.—Bids will be received until Aug. 8 by J. M. Simeal, Clk. of Council, 69 Harrison Ave., for grading, curbing and paving a portion of Ellsworth Ave.; approximate quantities: 7,341 cu. yds. excavation; 2,350 lin. ft. dressed stone curbing; 90 lin. ft. rough stone curbing; 3,950 sq. yds. paving. John McBride, Boro. Engr., Rm. 46, Fidelity Bldg., Pittsburg.

Philadelphia, Pa.—The Common Council is stated to have approved the bill providing for the paving with asphalt 68 streets throughout Philadelphia.

Meadville, Pa.—Bids are wanted Aug. 9 for grading, paving and curbing Chestnut St. with vitrified brick, asphalt block or sheet asphalt, as advertised in The Engineering Record.

Jersey Shore, Pa.—Busch & Stewart, of Williamsport, Pa., have secured the contract for paving (bids opened July 29), $1.80 per sq. yd., for 9,000 sq. yd. of paving, using Clearfield block on a 6-inch concrete foundation.

**West Homestead, Pa.*—Frank E. Erbeck & Co., of Homestead, are stated to have received the contract for paving and grading all the streets in the borough for $61,000.

Dallas, Tex.—It is stated that the estimates of Engr. Uhl for constructing roads are as follows: Fort Worth Road, 15 miles long, $32,977; Beckley Road, 13 miles, $36,211; Lancaster Road, $7,926; East Pike, 14 miles, $24,848; Richardson Road, 14 miles, $20,000 and Preston Road, 13 miles, $15,806.

Salt Lake City, Utah.—Geo. W. Riter, City Engr., writes that there is some talk of paving State St., from N. Temple to the State Capitol grounds, but no definite action has yet been taken.

Suffolk, Va.—It is stated that bids will be received until Aug. 15 by J. H. MacLeary, Chmn. Street Com., for about 1,500 sq. yd. each of bitulithic, asphalt and concrete street paving.

Seattle, Wash.—Bids will be received by C. B. Bagley, Secy. Bd. of Pub. Wks., until Aug. 12th, for concrete sidewalks on Roy and other streets; estimated cost, $5,650, and Northlake Ave. and other streets at an estimated cost of $55,000.

Milwaukee, Wis.—The Western Paving & Supply Co. is reported to have received the contract for paving with asphalt on 12th St., at $2.20 per sq. yd.

R. J. Hickey is stated to have received the contract for paving with brick a portion of Jackson St., at $1.74 per sq. yd.

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Ensley, Ala.—A mass meeting here on July 27 voted unanimously for the construction of a municipal electric light plant. N. W. Scott, Mayor.

Jonesboro, Ark.—It is reported that the Jonesboro Improvement District will expend about $220,000 for the purchase of the water and lighting plants, and the construction of a sewerage system.

Luxora, Ark.—Wm. Wood, of the Luxora Water & Light Co., writes that it is proposed to construct an electic light plant at a cost of $3,000.

Ukiah, Cal.—It is stated that bids will be received until Sept. 6 for a franchise to maintain certain electric transmission lines along public highways.

Denver, Colo.—See "Water."

Denver, Colo.—It is reported that the Denver Gas & Electric Co. (F. W. Frueauff, Secy.) will expend about $150,000 in improvements.

Washington, D. C.—Bids will be received by Elliott Woods, Supt. U. S. Capitol Bldgs. and Grounds, until Sept. 30, for furnishing material, labor, and other appliances, and erecting and putting in operation, in a building on foundations to be provided by the United States, and in locations within the Capitol, Congressional Library and Senate and House Office Buildings, now under construction, a complete heating, lighting and power plant, including machinery, boilers, piping, etc., as advertised in The Engineering Record.

St. Augustine, Fla.—John M. G. Carrera, City Clk., writes that the citizens voted July 18 for municipal electric light plant and extension of water works. The citizens also voted, same date, to grant a franchise for electric lighting to T. R. Osmond.

Marianna, Fla.—The citizens are reported to have voted to issue $9,000 bonds to construct an electric light plant and $4,000 bonds to enlarge the water works.

Roodhouse, Ill.—The Roodhouse Light, Heat & Power Co. has been incorporated with a capital of $30,000, to operate a light, heat and power plant. Edmund C. Kreider, Sr., is one of the incorporators.

Shawneetown, Ill.—A. M. Searles is reported to have secured a franchise for water works and an electric light plant.

Goshen, Ind.—The Hawks Electric Co. is reported incorporated with a capital of $36,500, by F. E. Hawks, O. C. Cover and others.

Logansport, Ind.—The Logansport & Wabash Valley Gas Co. is reported to have decided to construct at once a fuel gas plant to supply Wabash, Logansport and Peru. Saml. Murdock, of Lafayette, is reported interested.

Newport, Ind.—The Town Trus. are reported to have granted E. E. Sayler, of Saybrook, Ill., a franchise to install an electric light plant at Newport.

Panora, Ia.—The Electric Light Co. is reported to have under consideration the construction of an electric light plant on the river at Rees' Mill.

Valley Junction, Ia.—It is reported that the Capital City Gas Light Co. may build a gas plant.

Lewisport, Ky.—Jesse Emmick is reported interested in the construction of an electric light plant.

Stoughton, Ky.—Bids will be received until Aug. 12 by the Electric Light Com. (John Holtan, Chmn.) for the following electrical apparatus and power equipment: 100-kw., belted, 3-phase alternator; 100-kw. steam turbo alternator, 2 switchboards with instruments; 75-light, constant,

*Items marked thus give the names of parties awarded contracts.

current transformer; 50 series, alternating-current, enclosed arc lamps; water wheel governor for two 100-hp. wheels, a 150-hp. boiler, and a boiler feed pump and heater.

Somerset, Ky.—Bids will be received until Aug. 14 by T. R. Griffin, Mayor, and Bd. of Council for a 20-year franchise to erect, maintain and operate an electric light plant for the purpose of lighting the streets, alleys, buildings and public grounds of the city.

Marksville La.—Bids will be received by the Mayor and Bd. of Aldermen until Aug. 24 for the construction of water works and an electric light plant. Bids will also be received on Aug. 29 for the purchase of $15,800 bonds, both proposals advertised in The Engineering Record.

Wilson, La.—The question of constructing water works and an electric light plant is reported under consideration here.

**Oldtown, Me*—The Milford Const. Co. (Wallace C. Johnson, Niagara Falls, N. Y., Ch. Engr.) has closed a contract with Jas. B. Mullen, of Bangor, Me., for constructing its dam and power house. The plant consists of a concrete dam about 1,000 ft. long across Penobscot River, at Oldtown, giving about 25 ft. head, and a power house containing 12 1,000-hp. generators direct connected to water wheels. Water power has been used at this point for several years. About 3,500 hp. is now in use, produced by a wing dam and canal along the west bank of the river. The power produced by the new plant will be transmitted to Bangor, 15 miles away.

Oakland, Me.—Harvey D. Eaton, of Waterville, Pres. Messalonskee Electric Co., writes that it is proposed to construct an electric light plant at Oakland, to cost $125,000. L. Metcalf, Engr., 14 Beacon St., Boston, Mass.

Baltimore, Md.—Archts. Simonson & Pietsch, Hoen Bldg., are reported to be preparing plans for a power house, to be erected at Westport, for the United Electric Light & Power Co.

Springfield, Mass.—The Directors of the Springfield Gas Light Co, are reported to have voted to build a new holder, with a capacity of 2,000,000 cu. ft.

L'Anse, Mich.—The Superior Constr. Co., of Houghton, is reported to be preparing plans for a municipal lighting plant for L'Anse.

Standish, Mich.—The Rifle River Power Co. has petitioned the Bd. of Supervisors of Arenac County, at Standish, for permission to construct 3 dams across Rifle River, the power developed to be used for electrical purposes. Geo. D. Silsby, Pres.; Frank F. Kleinfield, Secy., and H. E. Terry, Engr., all of Saginaw.

Hazlehurst, Miss.—The citizens are reported to have voted to issue $10,000 bonds, to be used for enlarging the school grounds, adding more water mains, and increasing the lighting facilities.

**Kansas City, Mo.*—F. E. Newberry & Co., of St. Louis, have secured the contract for conduits and wiring for U. S. Postoffice (bids opened July 21) for $2,162.

Joplin, Mo.—The Spring River Power Co. is reported to be about ready to let contract for the construction of a 4,000-hp. steam plant.

Skidmore, Mo.—The question of lighting this place by electricity is reported under consideration.

Brooklyn, N. Y.—Bids will be received until Aug. 14 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for installing electric equipment in Erasmus Hall High School, Boro. Brooklyn, and in school No. 87, Middle Village, Boro. of Queens.

Lockport, N. Y.—The Council is reported to have granted the Niagara Falls Electrical Co. a franchise for the use of the streets of the city, for light, heat, power and electrical transmission purposes.

Salamanca, N. Y.—This village proposes to take over the present water and lighting plants on Jan. 1, 1906 if it is voted so at the special election, to be held soon.

Lake Placid, N. Y.—The date of opening of bids for constructing an electric light plant has been extended from Aug. 3 to Aug. 14, as advertised in The Engineering Record.

Plymouth, O.—It is stated that bids are wanted Aug. 9 by John T. Bulman, Clk. Bd. Pub. Affairs, for machinery and equipment for an electric and water plant.

Lewisburg, Pa.—Philadelphia capitalists are reported to have purchased the plant of the Lewisburg Gas & Electric Co., and will make some improvements.

Millersburg, Pa.—Dreibelbis & Co., 548 Court St., Reading, are reported to be completing plans for the construction of a 50,000 hp. plant about a mile north of Millersburg, along the Susquehanna River; probable cost of work proposed reported to be $1,500,000.

Hartsville, S. C.—There is reported to be some talk of constructing water works, a sewerage system and electric light plant here.

Sumter, S. C.—The Sumter Electric Light Co. is reported incorporated, with a capital of $200,000.

Belle Fourche, S. D.—The Belle Fourche Power & Water Co. is reported to have secured a franchise for an electric light plant.

Whitney, Tex.—Collier Bros. are reported interested in the construction of an electric light plant at Whitney.

Temple, Tex.—H. C. Bancroft and F. D. Lyon, of Houston, are reported to have formed a company to construct a gas plant, to cost about $60,000. About 10 miles of mains will be laid.

Tacoma, Wash.—The Mountain Home Electric Co. is reported incorporated, with a capital of $30,000, by J. J. Hewitt, of Tacoma, and Seymour H. Bell, of Sumpter, Ore.

Shawano, Wis.—The Flattock Water Power Co., of Shawano, is reported incorporated with a capital of $50,000 by W. C. Zachow, Chas. H. Hartley and Frank S. Baker.

Laramie, Wyo.—W. C. Sterne, of Littleton, Colo., Secy. Arapahoe Electric Co., of Littleton, is reported interested in the construction of an electric light plant at Laramie.

Winnipeg, Man.—Bids will be received by J. C. Gibson, Chmn. Fire, Water and Light Committee, until Aug. 28, for supply of producer gas plant, of capacity of 2,500 continuous engine brake hp.; also 500-kw. electric-generaing plant, as advertised in The Engineering Record.

Chatham, N. B.—Press reports state that steps are now being taken to refit and enlarge the electric light plant, at a cost of $35,000. Engineer Kelch, of Montreal, Que., is stated to be preparing a report, which will be submitted to a special meeting of the ratepayers, to be held soon.

Moose Jaw, N. W. Ter.—Bids will be received until Aug. 21 by John D. Simpson, Secy.-Treas., for a 200-hp. boiler, 350-hp. engine, condenser feed pump and heater, 225-kw. alternating-current generator, exciter and switchboard.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Birmingham, Ala.—Bessemer citizens are stated to have organized a company to construct and operate an electric railway around the various suburbs of that place. The new line is intended to extend to Jonesboro, Dolomite, Ensley, Thomas and other mining and manufacturing camps in the lower part of the county, and will be used as a branch line later for a line to Tuscaloosa County. It is proposed to secure $25,000 subscriptions from among the citizens with which to make the survey and start the first work.

Troy, Ala.—Troy people propose to build an electric railway from Troy to Elba, to locate the power plant at Elba, on Pea River, and to furnish power for manufacturing enterprises along the line. A stock company, with $100,000 capital, is reported organized, with J. M. Garrett, of Elba, as Pres.; Y. W. Rainor, Vice-Pres., and W. B. Perdue, Dir.

San Francisco, Cal.—It is stated that the Vallejo, Benicia & Napa Valley R. R. So. contemplates an extension through the Napa Valley to Calistoga and thence into Lake County. J. W. Hartzell, the promoter, is endeavoring to arrange for building an electric road from Vallejo to Suisun, Vacaville and Winters. It is the intention to connect with the Vallejo, Benicia & Napa Valley near Napa.

St. Augustine, Fla.—The citizens are reported to have voted to grant T. R. Osmond a franchise for an electric railway.

Bluffton, Ind.—The Muncie, Hartford City & Ft. Wayne Co. is stated to have decided to build to Ft. Wayne.

Booneville, Ind.—The Evansville & Newberg Traction Co. is stated to have received a franchise to enter the city and run to the Public Sq. The Tennis Constr. Co. will construct the line.

Davenport, Ia.—It is reported that there is still another project on foot for the construction of an electric railway to connect Iowa City and Davenport. Three companies have already been formed for this purpose, all of which have made surveys. No construction work has been done by any of the three as yet. Now the business men of Davenport, recognizing the benefit to be derived from such a line, have had a survey made, and are promoting the construction of a line. This survey parallels the Rock Island road for the entire distance between the two cities, touching the towns of Stockton, Wilton Junction, Moscow, Attalissa, West Liberty and Downey. At a mass meeting of the business men of this city held recently it was decided to authorize a committee to solicit stock subscriptions for a company to construct and operate such a line, and if this committee meets with the success in this work expected, then the company is to be formed and the actual work of construction started at an early date.

Des Moines, Ia.—The Central Ry. Co. is reported organized in this city for the purpose of constructing, equipping and operating electric interurban railways in Iowa and other States. Capital was fixed temporarily at $25,000 and Des Moines will be headquarters for the company. The first proposed line under consideration is one from Des Moines to Ames, a distance of about 37 miles. Thos. J. Wilcox, of Clinton, Pres.; B. S. McCully, of Princeton, Treas.; D. L. Wilcox, of Des Moines, Secy.

Greensburg, Ind.—It is stated that a traction line from this city to Madison and the Ohio River is being promoted. The proposed line will connect with the Cincinnati & Shelbyville line out of Indianapolis. It is said that the Indianapolis & Cincinnati Co. has no interest in the Madison line, but is giving it every encouragement.

Indianapolis, Ind.—It is stated that the electric belt railroad which the people behind the Indianapolis, New Castle & Toledo Electric Ry. propose to build, is to be double tracked. A right of way 100 ft. in width has been obtained for it. Options have been taken on all property that will not have to be condemned, so that more than two tracks may be laid if the demand of the road's traffic should ever require more. The belt will be 40 miles and it will intersect every steam and electric railway entering Indianapolis. C. S. Hernly, W. E. Stevenson, E. H. Bundy and Eli Marvin are associated in the proposed new belt. The organization of the company has not yet been completed.

Fairfield, Ia.—It is stated that the business men of Fairfield and Keosauqua have decided to have a survey made for an electric railway connecting the two cities. A committee was appointed to solicit for the necessary funds to carry on this survey. The committee has been at work several days, and has now secured enough funds to pay for the survey. An engineer will be secured at once. As soon as the survey is completed the plats will be submitted to contractors and prices obtained on the construction of the road, including equipment. It is estimated that it will cost $200,000 to construct and equip the line.

Paris, Ky.—The construction of an interurban line from Paris to Maysville, passing through Paris, Millersburg, Carlisle, Blue Lick Springs, Mays Lick, Fairview, Washington and Maysville, is reported under consideration. Evan Lloyd, Germantown, Ky., is reported interested.

Athol, Mass.—It is reported that consideration is being given here to a project to build an electric railway from Barre to Baldwinville, running through Petersham, Phillipston and Templeton. In furtherance of this project, it is stated that J. H. Hutchins, of Athol, has secured control of excellent water power at Queen Lake, Phillipston.

Boston, Mass.—It is stated that within a month work will begin on the construction of an electric railroad between Worcester and Hartford, Conn., to be known as the Hartford & Worcester St. R. R. Co. It will be built and managed by the same interests which control the Boston & Worcester St. Ry., and will form practically a continuous line from Boston to Hartford. The cost of the system will be about $3,000,000.

Fitchburg, Mass.—Locations in Fitchburg petitioned for by the new Fitchburg & Princeton St. Ry. Co., are stated to have been granted by the Fitchburg Bd. of Aldermen. The proposed road will make connections with the northern terminus of the Worcester & Northern St. Ry. Co.

Pittsfield, Mass.—C. K. Stearns, 93 Federal St., Boston, is reported to be preparing plans for a power house for the Street R. R. Co. New machinery will be required. It is proposed to expend $100,000.

Kalamazoo, Mich.—It is reported that Col. Jacobs, of Chicago, will build an electric railway from Battle Creek to the western end of Gull Lake, and from Kalamazoo to Gull to Grand Rapids. Construction work will start this fall. Preliminary surveys have been made on the right of way between Battle Creek and Grand Rapids. This is a part of the system which will eventually connect Grand Rapids and Indianapolis. Grading is being done on the line between Warsaw and Goshen, Ind. C. W. Studell, formerly with the Atchison, Topeka & Santa Fe Railroad, is associated with Col. Jacobs in the enterprise.

Manistique, Mich.—A committee of the Merchants and Manufacturers' Assoc. of Manistique is stated to have investigated the possibilities of an electric road to connect Manistique and Garden. The committee estimates the cost of building the road at $100,000. The Manistique Light & Power Co. offers to furnish power for operating the road, if it is built.

Paterson, N. J.—It is reported that the State Line Traction Co. is soon to commence the work of extending the line of the Public Service Cor. in North Paterson to Ridgewood. It is the ultimate intention of the company to extend across the New York State line, touching Hohokus and then running over to Greenwood Lake.

Rochester, N. Y.—The Rochester & Southern Constr. Co. is reported incorporated with a capital of $100,000. The purpose of the company is the construction of an electric railway from Elmira to Rochester. A. Cullen, of Newark, N. J., Pres.; T. S. Mulcahy, of Rochester, Secy.; Geo. A. Engert, of New York City, Treas. and Mgr.

Auburn, N. Y.—The Auburn & Syracuse Electric R. R. Co. is stated to have decided to double track its line from Syracuse to Skaneateles Lake, a distance of 20 miles. Five miles of the work have already been completed, but it was not the original intention to complete the work at present. About $300,000 is to be spent in the improvements and the new equipment required.

Troy, N. Y.—It is reported that work will be started within a month on an extensive system of electric railways connecting Lake Champlain and Lake George with Schroon and Placid Lakes. The company was recently incorporated under the name of the Ticonderoga Union Terminal R. R. Co. The company intends to erect dams for the development of power. Options have been secured on desirable water-powers. Directors are I. Rothschild, A. B. Adkins and W. W. Richards, of Ticonderoga, and Frank B. Gridley and N. R. Holmes, of Troy, and others.

Dayton, O.—The Oakwood St. Ry. Co. is stated to have petitioned the Council for extensions to the northern end of Salem Ave., thus giving the city line facilities to College Park, Dayton View and other suburbs. It is understood the improvement will be made at once, and that, in addition, a new bridge over the Miami River at Monument Ave. or First St. will soon be constructed.

Findlay, O.—The Lima-Findlay Electric Ry. ordinance is stated to have been passed by the Findlay City Council.

Lorain. O.—It is reported that the Cleveland & Southwestern Traction Co. contemplates constructing an electric line from Lorain to Oberlin via North Amherst, the preliminary surveys of which are now in progress.

Norwalk, O.—The Sandusky, Norwalk & Mansfield Electric Ry. Co. is reported to have applied to the County Comrs. for a franchise on Tiffin St., through the subway, to enable it to reach Myrtle Ave., at Chicago Junction.

Toledo, O.—The Toledo, Defiance & Southern Ry. Co., of Defiance, is reported incorporated with a capital of $10,000, by A. K. Detwiler, T. T. Ansberry, L. R. Schenck and others.

Wooster, O.—The Barberton, Wadsworth & Western Traction Co. is stated to have under consideration the construction of a line from Barberton to Ashland. The company states that it has secured all of the right of way between Creston and Ashland, and work of taking right of way from Creston to Wadsworth is now in progress.

**Shamokin, Pa.*—The contract for building the street railway from Shamokin to Sunbury has been awarded to Contractor Pascoe.

York, Pa.—The plant of the Delta Electric Light Co., located along Muddy Creek, is stated to have been purchased by the York Furnace, Pequa & Lancaster Electric Ry. Co. The purchase was made for the purpose of furnishing power for the proposed new trolley extension into York County.

Austin, Tex.—The Attorney-General has approved and the Secy. of State will file the charter of the Gainesville, Whitesboro & Sherman Electric Ry., capital $500,000, principal office at Gainesville. Purpose to connect Gainesville, Whitesboro and Sherman with an electric railway, a total distance of 32 miles. Incorporators: G. A. Hassinger, H. L. Lazarus, of New Orleans; H. G. Stinnett, of Sherman; O. B. Cowell, of Whitesboro; John King and others, of Gainesville.

**Ft. Worth, Tex.*—Contract for the construction of 6 miles of street railway has been let by the Arlington Heights Co. to W. P. Engle and J. C. Cole, of Alliance, O.

Guthrie, Okla. Ter.—The United Trolley Improvement Co., of Guthrie and New Jersey, with $100,000 capital, is reported to have filed its charter here. Incorporators: Ernest T. Preston, of Monmouth County, N. J.; Ernest T. Andrews, of Norfolk County, Mass., and H. W. Pentecost, of Guthrie.

San Marcos, Tex.—Bids for the construction of the San Marcos Valley Interurban Ry. will soon be received. J. H. Jennings, Vice-Pres. It is understood that all the money necessary for the building of the road from San Marcos to Luling is available now.

**Items marked thus give the names of parties awarded contracts,* *Tecumseh, Okla. Ter.*—Alfred Hare is stated to have decided to build an interurban line between Shawnee and Tecumseh.

Salt Lake, Utah.—Barney Mahler, of Cleveland, O., announces that his interurban electric line will be built just the same as though he had secured the franchise through the streets of Ogden. The route of the proposed line is through Payson, Spanish Fork, Springville, Provo, Pleasant Grove, American Fork, Lehi, Salt Lake, Bountiful, Slaterville, Perry, Plain City, Willard, Brigham City, Wellsville, Hyrum and Logan. In addition to this, there will be a branch line running north from Logan through Greenville, Hyde Park, Smithville and Richmond to Preston. The work of grading and bridge building will be pushed this fall and winter. Steps will be taken at once to incorporate.

Janesville, Wis.—It is stated that surveyors are staking out the interurban line from Janesville to Madison, which means extension of the Rockford, Janesville & Beloit Interurban line, and within a few months through interurban service from Chicago to Madison via Elgin, Belvidere, Rockford and Janesville.

Hamilton, Ont.—It is stated that work on the Hamilton-Brantford Electric Ry. will be commenced at once.

RAILROADS.

Notes Arranged Alphabetically by States.

**Warrior, Ala.*—The Louisville & Nashville R. R. Co. is reported to have awarded to Dunn & Leland, of Birmingham, Ala., the contract to build an extension of 20 miles from the road known as the North Alabama to the Vulcan mines of the Warrior field; the cost will be about $500,000.

Paris, Ark.—The Southside Coal & Ry. Co. has been incorporated, to build a standard-gauge road from Paris to Dardanelle, a distance of 38 miles, with a branch to intersect the main line at Shoal Creek, a distance of 4 miles, and another branch to intersect the main line at Cane Creek and run in a northeasterly direction, a distance of 8 miles; capital, $1,250,000. Directors: T. D. Kinman, Anthony Hall, Henry Strother, and others.

Earl, Ark.—The Crittenden R. R. Co. has been incorporated to build a standard-gauge road from Earl in a southerly direction to Heth, a distance of 15 miles; capital, $150,000. Directors: R. E. Stonebraker, N. H. Walcott, C. C. Gardener and others.

Deckerville, Ark.—The Deckerville, Hydrick & Western R. R. Co. has been incorporated, to build a standard-gauge road from Deckerville through Poinsett, Crittenden and Cross Counties, a distance of 27 miles; capital, $216,000. Incorporators: G. W. Patterson and E. B. Smith, of Earl; C. B. Bailey, of Wynne; Herman A. Black, of Vanndale, and others.

Jacksonville, Fla.—The Live Oak & Perry Ry. Co. has been incorporated, with Thos. Dowling, Pres. and O. D. McFarland, Secy., to build 165 miles of railroad from Jacksonville to St. Marks, passing through the counties of Duval, Baker, Columbia, Suwanee, Lafayette, Taylor, Jefferson and Wakulla; capital, $2,000,000.

Rockford, Ill.—The Rockford Industrial R. R. Co. has been incorporated, with office at Chicago, and a capital of $10,000, to construct a belt railroad in Rockford. Incorporators: Sidney F. Andrews, Andrew P. Humburg, Chas. E. Ferich, and others, all of Chicago.

Palatine, Ill.—The Illinois & Wisconsin Ry. Co., with principal office in Chicago, is reported incorporated, with a capital of $10,000, to construct a line from Palatine through the counties of Cook, Lake and McHenry, to McHenry, Ill. Incorporators: Geo. M. Steven, Henry Lutzenkirchen, Geo. W. Bryson and others, all of Chicago.

Shreveport, La.—The Shreveport & Northwestern R. R. Co. is reported incorporated, with a capital of $2,000,000, to construct a railroad from Shreveport through the parishes of Caddo, Bossier, Webster, Claiborne and Union in Louisiana, and through the State of Arkansas to Memphis, Tenn. A. K. Clingman, of Caddo, Pres.; A. Kinnebrew, of Homer, Vice-Pres., and S. C. Fullilove, of Shreveport, Secy.

**Baltimore, Md.*—The Baltimore & Ohio R. R. Co. is reported to have awarded to the Chesapeake Constr. Co., of Baltimore, the contract for extending the double track of the Metropolitan branch from Gaithersburg to Germantown, a distance of 4 miles. On this branch it is purposed to construct a viaduct 400 ft. long and 90 ft. high over Big Seneca Creek, east of Germantown. The contract for double tracking the line between Barnesville and Dickerson, about 2 miles in length, has been awarded to F. H. Clement & Co., of Philadelphia. The wooden trestle over Little Monocacy Creek, west of Barnesville, will be replaced by a masonry viaduct consisting of three 9-ft. semicircular arches; cost of the two contracts is about $600,000.

Westminster, Md.—The Western Maryland R. R. Co. (J. Q. Barlow, Ch. Engr. Cumberland, Md.), is reported to have under consideration the locating of a low-grade line from some point on the main line at or above Westminster direct to Williamsport.

Natchez, Miss.—The Mississippi Central R. R. Co. (M. H. McCabe, Supt., Hattiesburg) is reported to have decided to extend its line to Natchez.

Liberty, Miss.—It is reported that surveys are being made for extending the Liberty-White R. R. (J. J. White, Pres., McComb City, Miss.) from Liberty to Natchez, Miss.

Omaha, Neb.—The Union Pacific R. R. Co. (John B. Berry, Ch. Engr., Omaha) is reported to have decided to double track about 100 miles of its road. The company will also adopt the motor car generally on branches and suburban lines.

The Great Northern R. R. Co. (A. H. Hogeland, Ch. Engr., St. Paul, Minn.) is reported to have decided to build a line to Omaha from some point on the new line from Sioux City, Ia., to Ashland, Neb.

Guymard, N. Y.—It is reported that the cost of the construction of the cut-off planned by the Erie R. R. Co. (Francis Lee Stuart, Ch. Engr., New York City), a line about 40 miles, from Guymard, by Campbell Hall, N. Y., to Highland Mills, is to be met out of the proceeds of part of an issue of $10,000,000 first mortgage bonds of the Erie & Jersey Railroad Co., recently incorporated to build the new line.

Cleveland, O.—The Cleveland Short Line Ry. Co. is stated to have secured right of way which will not only permit a road with a reasonable grade, but one which will directly connect all other railroads, with the exception of the Wheeling & Lake Erie, and will avoid all grade crossings, besides touching most of the industrial institutions along the route. It is the intention as soon as the proper legislation can be obtained in Cleveland to begin the construction of the road. It will be built in three sections. One will be 20 miles in length, extending from Fairport to Collinwood. The second section will be 20 miles in length, extending from Collinwood to Rockport, and the third will be 20 miles in length, extending from Rockport through to Lorain. It is the intention first to build this middle section, and when that has been completed to proceed with the less important and less difficult work of building the first and third sections of the road. The road is promoted by and will be built under the direction of Attorney W. R. Hopkins, his brother, Ben F. Hopkins, and M. A. Fanning.

**Pittsburg, Pa.*—The Directors of the Midland Steel Co. are reported to have awarded the contract for the construction of a spur from the Cleveland & Pittsburg R. R. to the site of the proposed blast furnace at Neal Station, to the Chas. A. Sims Contr. Co., of Philadelphia, for $40,000. The company is now preparing to build a blast furnace and steel plant.

The Jones & Loughlin Steel Co. is reported to have taken up the matter of completing plans for its proposed railroad to the Great Lakes. Construction work will probably be started in the fall.

San Angelo, Tex.—The Santa Fe. R. R. Co. (C. F. W. Felt, Div. Ch. Engr., Galveston, Tex.) is reported to have decided to build an extension of its Lampasas branch from San Angelo, Tex., to Rincon, N. M., where connection will be made with its transcontinental line.

Abilene, Tex.—J. D. Beardsley, of Gibsland, La., is reported interested in the construction of a railroad from Abilene, Tex., to Seymour, Tex., 80 miles.

Buchanan, Va.—John F. Hager, of Ashland, Ky., writes that the Buchanan & Tazewell R. R. Co. is to construct a railway in Virginia. For further information address C. M. Crawford, Coal Grove, O.

North Yakima, Wash.—The North Yakima Valley R. R. Co., of North Yakima, is reported incorporated by Geo. Donald and M. H. Grover, with a capital of $1,000,000.

Seattle, Wash.—The Short Line Development & Construction Co. has been incorporated with a capital of $3,000,000, with headquarters at Seattle. Incorporators: Thos. Flammer and Martin Bosworth, of Seattle, and Grant Hamilton, of Denver, Colo. The object of the company is to build railroads in Alaska.

Morelia, Mexico.—The Morelia & Tacambara Ry. Co. is reported formed, with a capital of $6,000,000, to construct a new railway in Mexico, about 225 miles in length, to connect with the Mexican Central. E. J. Chamberlain and G. E. Fauquier, of Ottawa, Ont., are Pres. and Vice-Pres., respectively, and J. D. Greatsinger, formerly Pres. of the Brooklyn Rapid Transit Co., Brooklyn, N. Y., is 2d Vice-Pres.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

**Columbiana, Ala.*—The Bynum Constr. Co., of Montgomery, Ala., it is stated, has received the contract to erect the court house at $72,000.

Ft. Wm. H. Seward, Alaska.—Bids will be received until Aug. 24 by Capt. F. A. Grant, Quartermaster, Seattle, Wash., for the construction, plumbing, heating and electric wiring of 5 public buildings at Ft. Wm. H. Seward.

Los Angeles, Cal.—Bishop Conaty, of the diocese of the R. C. Church, it is stated, has announced that $225,000 has been given to the home of the Little Sisters of the Poor, which is soon to be erected.

San Francisco Cal.—The following are the bids opened on July 20 by the Superv. Archt., Treas. Dept., Washington, D. C., for the construction of U. S. Custom House at San Francisco (bidders of San Francisco, unless otherwise mentioned): Pacific Constr. Co., $1,298,573; Raymond Granite Co., $1,315,680; Thos. Butler, $1,194,000; F. H. Barnes, $1,349,915; Wilson Lyons Constr. Co., $1,540,341; Healy, Tibbetts & Co., $1,389,000; Wm. Webb, Beaumont, Tex., $1,235,000; General Supply & Constr. Co., New York, N. Y., $1,241,000, and Hill-O'Meara Constr. Co., St. Louis, Mo., $1,324,000.

Ft. DuPont, Del.—Bids will be received by Capt. Louis F. Garrard, Jr., Q. M., U. S. A., Delaware City, until Aug. 28, for constructing, plumbing, etc., one frame barrack and one brick storehouse at Ft. DuPont, as advertised in The Engineering Record.

Washington, D. C.—See "Power Plants, Gas and Electricity."

Washington, D. C.—The following are the bids opened on July 29 at the office of Elliott Woods, Supt. U. S. Capitol Bldg. and Grounds, for cut stone work for exterior facades and court walls of office building for U. S. Senate: Vermont Marble Co., Proctor, Vt., for Vermont marble, (7 bids) ranging from $1,198,000 to $1,523,700; Norcross Bros., Worcester, Mass., for Georgia marble, $1,545,000; Woodbury Granite Co., Hardwick, Ga., (granite) $1,637,000, (grey granite) $1,364,000; B. H. & G. N. Williams, New York, N. Y., (S. Dover) $1,640,000, (Georgia) $1,556,595; W. Bradley & Son, New York, N. Y., (Bedford limestone) $805,555; Thos. Reilly, Philadelphia, Pa., (Indiana marble) $1,420,000, (Kenesaw granite) $1,025,000, (Vermont marble) $1,385,000, (Bedford limestone) $799,000; Furst & Forney, Chicago, Ill., (limestone) $779,000; Booth Bros. & Hurricane Isle Co., New York, N. Y., (Mt. Waldo Island) $1,442,000, (Fox Island) $1,359,000, (Waldoboro) $1,442,000; Blue Ridge Marble Co., Cherokee, Ga., (marble) $1,333,000; New England Granite Wks., Rutland, Vt., (2 bids) $1,365,000 and $1,345,000; John Pierce, New York, N. Y., (Mt. Waldo) $1,427,500; Broderick Constr. & Eng. Co., New York, N. Y., (Alabama marble) $1,296,000.

Bids were opened at the bureau of supplies and accounts, Navy Dept., Aug. 1 for the construction at the Naval Hospital of a power house 88 ft. 6 in. long by 36 ft. wide, with 16 ft. clear head room, and of a perforated radial molded brick chimney 75 ft. high, with an internal diameter of not less than 3 ft. 8 in. The only bid received for the power house, it is stated, was that of the General Supply & Constr. Co., of New York, at $18,391. Bids for the construction of the chimney, it is reported, were as follows: General Supply & Constr. Co., New York, $3,900; H. R. Hernicke, New York, $1,983.50; M. W. Kellog, New York, $1,943; Custodis Alphonse Chimney Constr. Co., New York, $2,375; Weber Steel Cement Chimney Co., Chicago, Ill., $2,250, and Royce & Ricketts, Washington, D. C., $1,970.

**Honolulu, H. I.*—The Burrell Constr. Co., of Portland, Ore., it is reported, has secured the contract to erect 25 buildings for the government at Honolulu at a total cost of about $280,000.

Council Bluffs, Ia.—The Bd. of Directors of the Women's Christian Assoc., it is stated, has accepted the gift of J. D. Edmundson, of Des Moines, of $40,000 on condition that $10,000 is raised by the Assoc. This sum is to be used to erect the Jenny Edmundson Hospital.

Caldwell, Idaho.—It is reported that bids will be received until Aug. 21 by the Co. Comrs. (John A. Tucker, Clk.) for erecting a court house. Wayland & Fennell, Archts., Boise.

Hoopeston, Ill.—Bids will be received until Aug. 17 by H. C. Green, Chmn. Bldg. Com., for furnishing materials and erecting a boiler and pump house at the pumping station.

Muncie, Ind.—The following are the bids opened on July 25 by the Superv. Archt., Treas. Dept., Washingon, D. C., for the construction, complete, of U. S. Post Office at Muncie: Cramer & Son, Muncie, $55,000; W. J. Turner Co., Chicago, Ill., $53,860; Morrow & Monroe, Muncie, $45,437; Edw. Henry, Tipton, Ind., $61,534; Miller & Co., Middletown, $53,460; E. W. Reid, Flint, Mich., $51,460; W. J. McAlpine, Dixon, Ill., $52,800; King Lumber Co., Charlotteville, Va., $59,437; J. G. Unkefer & Co., Chillicothe, O., $56,264; Sanders & Delamore, Portland, Ind., $59,670; H. A. Paine, Albert Lea, Minn., $57,946.

**South Bend, Ind.*—The Keegan Constr. Co., of South Bend, has secured the contract for erecting the County Asylum for $72,000.

Louisville, Ky.—The following are the bids recently received by the Superv. Archt., Treas. Dept., Washington, D. C., for painting and repairs at U. S. Post Office, Louisville; John Ryan, Louisville, $7,292; Wm. Heaten, $7,800; C. F. Biersbaum, $14,118; W. H. Bradford. $9,847; Henry Schroder, Covington, $8,447, and R. F. Kinsella, Springfield, Ill., $7,240.

Franklinton, La.—Bids will be received until Aug. 26 by the Bd. Police Jury (J. Leon Pounds, Pres.) for furnishing material and erecting a court house; probable cost $22,000. Andrew J. Bryan, Archt., 708 Hennen Bldg., New Orleans, La.

Springfield, Mass.—The plans of Shepley, Rutan & Coolidge, of Boston, have been accepted for a new Hall of Records; cost about $50,000.

Flynn, Mich.—It is reported that $25,000 has been donated for the erection of a hospital here.

Minnehaha Falls, Minn.—The Trus. of the Soldiers' Home have accepted the plans submitted by A. F. Gauger, of St. Paul, for the new home for soldiers, their wives and widows and mothers of deceased soldiers, for which the Legislature has appropriated $75,000. The building is to be 3 stories high, of brick, and is to cost, not including heating, plumbing, etc., about $50,000. It is stated that bids for the construction will soon be asked.

St. Louis, Mo.—Bids will be received until Aug. 15 by Chas. F. Gallenkamp, Custodian, St. Louis, for the purchase and removal of certain government buildings lately used for the government exhibits at the La. Purchase Exposition, St. Louis.

The Baptist Orphan Home Assoc., it is stated, has purchased site in Overland Park for the erection of a $60,000 asylum. Address Secy.

Jefferson City, Mo.—H. H. Hohenschild, of Rolla, it is stated, has been selected to prepare plans for State Sanatorium for Tuberculosis, which it is proposed erecting.

Kansas City, Mo.—The following are the bids opened on July 27 by the Superv. Archt., Treas. Dept., Washington, D. C., for extension and changes to the low-pressure and exhaust steam heating and ventilating apparatus in U. S. Post Office and Court House at Kansas City: Carter McDonald, Kansas City, $21,967; Iowa Mfg. Co., Oskaloosa, Ia., $15,251, and E. J. McDonald, Chicago, Ill., $22,300.

It is stated that bids will be received until Aug. 15 by F. C. Gunn, Archt., Grand Office Bldg., for erecting 4 hospitals, estimated to cost $250,000.

Choteau, Mont.—It is reported that bids are wanted until Aug. 15 for erecting a brick court house. A. C. Warner, Co. Clk.; Shanbey & Gibson, Archts., Kalespell.

Lincoln, Neb.—Bids will be received by the Superv. Archt., Treas. Dept., Washington, D. C., Aug. 24, for ventilating and steam heating apparatus, etc., for the U. S. Court House and Post Office at Lincoln, as advertised in The Engineering Record.

South Omaha, Neb.—L. A. Davis, of South Omaha, it is stated, has been authorized by the City Council to prepare plans for a 2-story, 40 x 100-ft. fire hall.

Newark, N. J.—The following are reported to be the lowest bids on various portions of the work in connection with the erection of an engine house in the 3d Ward on Prince St., to be known as No. 19, and on Frelinghuysen Ave., Waverly section, to be known as No. 20: Engine house No. 19, mason and iron work, Satzler & Oberle, $8,500; carpentry, roofing and cornice, Chas. Schaedel, $6,250; plumbing, Jaehnig & Peoples, $689; steam heating, Elias Berla, $383; electric work, Browe & Sons, $427. Engine house No. 20, mason work, Meirs & Sons, $8,700; carpenter work, Wm. G. Sharwell & Co., $6,283; plumbing, Elias Berla, $759; steam heating, Jaehnig & Peoples, $589; iron work, Berlin Constr. Co., $1,748; electric work, $469.

New York, N. Y.—Bids will be received until Aug. 10 by the Park Bd. (John J. Pallas, Pres.) for furnishing materials and constructing a steam heating and ventilating apparatus in Aquarium Bldg., Battery Park, Boro. Manhattan. Also, same date, for repairs and alterations to the piping and valves, furnishing and installing new lead-lined pipe and valves, and repairs and alterations to the hot water heater in said building.

Bids will be received until Aug. 11 by John F. Ahearn, Pres. Manhattan Boro., for reroofing the new Washington Market.

The Dept. of Health, it is stated, has received the plans for the improvements on North Brothers Island,

**Items marked thus give the names of parties awarded contracts.*

which include an increase in acreage amounting to one-third its present size, the erection of 7 hospitals or pavilions, which are to cost about $150,000 each, 5 isolation ward buildings, to cost about $20,000 each, 2 chapels, a home for nurses and a storehouse. A sea wall is to be built on the eastern side of the island and a width of 200 ft. to be filled in, the cost to be about $150,000. The total cost of the improvements, including the enlarging of the island and the buildings, is reported to be in the neighborhood of $1,500,000. Westervelt & Austin, 7 Wall St., are the Archts.; Chas. W. Leavitt, Jr., 15 Cortlandt St., is the Landscape Archt.

**Rochester, N. Y.*—The Bd. of Contract and Supply, it is stated, has awarded the contract to erect the fire headquarters building on Central Ave. (bids received July 26) to Gorsline, Swan & Rice, Powers Bldg., at $71,365. The contract for plumbing, electric wiring and heating will be let under a separate contract.

**Washburn, N. D.*—O. B. Wing, Co. Aud., writes that the Pauly Jail Bldg. Co., of St. Louis, Mo., has secured the contract for erecting a jail at $14,948, and A. O. Reed, of Washburn, has the contract for erecting a court house at $2,945 (bids opened July 24).

**Jamestown, N. D.*—It is reported that the Northwestern Constr. Co., of Wahpeton, has received the contract to erect a 2-story ward building at the Insane Asylum, to cost about $30,000.

Fargo, N. D.—The following are the bids opened on July 24 by the Superv. Archt., Treas. Dept., Washington, D. C., for constructing, complete, (except elevator) the U. S. Post Office and Court House addition at Fargo: J. W. Miller, St. Paul, Minn., $70,683; Lauritzen Bros., Fergus Falls, Minn., $54,998, and H. W. Leighton, Minneapolis, Minn., $71,573.

Akron, O.—M. D. Buckman, County Aud., writes that all bids opened July 25 for erecting the court house have been rejected and new bids will be called for.

Enid, Okla. Ter.—The citizens are reported to have voted in favor of issuing $100,000 bonds for the erection of a court house. Bids for the erection will probably soon be asked.

Reading, Pa.—The Bd. of Directors of St. Joseph Hospital, it is reported, has decided to enlarge the building at a cost of about $50,000.

**West Chester, Pa.*—Cramp & Co., of Philadelphia, have secured the contract for constructing the U. S. Postoffice, complete (bids opened June 28), for $35,350.

Wilkesbarre, Pa.—It is reported that plans are being prepared for expending $30,000 for improving House of Mercy Hospital.

Spartansburg, S. C.—The following are the bids opened on July 26 by the Superv. Archt., Treas. Dept., Washington, D. C., for the construction, complete, of U. S. Post Office at Spartansburg: J. P. Hertoz, Spartansburg, $65,528; King Lumber Co., Charlottesville, Va., $53,721;

Huntsville, Tex.—It is reported that the State Penitentiary has been destroyed by fire.

Regina, N. W. Ter.—It is stated that competitive plans will be received until Sept. 1 by J. Kelso Hunter, Secy.-Treas., for a $60,000 city hall.

E. Hart, Norfolk, Va., $54,987; Mankin Constr. Co., Richmond, Va., $44,989; Miles & Bradt, Atlanta, Ga., $49,400; R. P. Wardrup & Son, Knoxville, Tenn., $48,776, and Fissell & Wagner, New York, N. Y., $47,600.

Seattle, Wash.—The Bd. of Pub. Wks., it is stated, has authorized the Secy. to receive bids for the excavation of the Keyser triangle, which is to be the site for the proposed new jail and hospital building. It is also stated that the Secy. has been authorized to receive competitive plans for the exterior elevation of the proposed building.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

Maricopa, Ariz.—It is stated that a combined hotel and station is to be erected here by the Southern Pacific R. R. (Wm. Hood, Ch. Engr., San Francisco, Cal.), at a cost of about $50,000.

**Los Angeles, Cal.*—The C. J. Kuback Co., Stinson Bldg., it is stated, has received the contract to erect a 4-story warehouse, 168 x 218½ ft., and a 1-story brick building, 150 x 218½ ft., for the Union Hardware & Metal Co., at E. First and Alameda Sts., the total cost to be about $96,790.

Denver, Colo.—F. G. Edbrooke, 510 Opera House Blk., it is stated, is preparing plans for an addition which the Colorado Telephone Co. contemplates erecting to its building on Champa St., at a cost of about $50,000.

The Knights of Columbus, it is stated, have purchased a site at 14th and Glenarm Sts., and intend erecting a $30,000 building.

It is reported that a 3-story building is to be erected at 15th and Arapahoe Sts. for the Thompson Fruit Co. by J. B. French. Cost, $45,000.

Savannah, Ga.—It is reported that the Seaboard Air Line Ry. (W. W. Gwathmey, Jr., Ch. Engr., Portsmouth, Va.) will expend $150,000 on its terminals. The improvements to include the erection of 2 brick warehouses, to have 5 compartments with 17-in. fire walls, cost $50,000; a cotton shed, 490 x 190 ft., cost $35,000, and another 750 x 115 ft., cost $25,000. For dredging out slips $23,000 is to be expended.

Chicago, Ill.—A new terminal station, to cost from $1,500,000 to $2,000,000, and to cover the land extending from Clark St. to State St., and from Polk St. to Taylor St., is to be constructed by the Chicago & Western Indiana R. R. (Edw. H. Lee, Engr., Dearborn Station), acting with other roads. Negotiations for the purchase of land fronting on Clark St., Plymouth and Custom House Courts are about concluded. Five railroads are reported interested in the new terminal station. They are the Wabash, the Santa Fe, the Erie, the Grand Trunk and the Monon.

Plans have been completed by D. H. Burnham & Co., Ry. Exchange Bldg., for a 12-story office building which David Mayer will build on Jackson Boule., between LaSalle St. and Fifth Ave., to cost $400,000.

Cook County Lodge, No. 240, I. O. O. F., will erect on Yale Ave. and 63d St. a 4-story lodge building, to cost $40,000.

Huehl & Schmid, 163 Randolph St., have completed plans for a mercantile building to be built for A. A. McKay, at 264-270 5th Ave., in place of one destroyed by fire last winter. The new building will be 8 stories high, 84 x 155 ft., and will cost $150,000.

M. H. Tichenor & Co., one of the leading stock yards firms for horses, are having plans prepared by Marshall & Fox for a stable to be built at 59th and Paulina Sts. The structure will be 2 stories high and cost $50,000.

A department store is to be erected at Milwaukee Ave. and Powell Pl. for Mrs. Kuhns, according to plans by W. C. Zimmerman, 21 Van Buren St. It will be 2 stories high and cost $40,000.

A new theatre is contemplated in the vicinity of W. North and Milwaukee Aves. Oscar F. Cobb & Son, 85 Dearborn St., are preparing the plans for the structure, which will be 2 stories high and cost about $50,000.

They are also preparing plans for remodeling the Calumet Theatre at 9206 South Chicago Ave. The improvements, which will include a steel stage and an automatic sprinkler system, will cost about $30,000.

Sellon & Harley have prepared plans for a 3-story store and flat building to be erected on 62d St., near Ellis Ave., for Bernard T. McShane. It will cost $25,000.

Sterling, Ill.—It is reported that the Eagles have adopted plans for a $25,000 lodge building. Address Secy.

Aledo, Ill.—It is reported that the Aledo Hotel Co. intends erecting a hotel at an estimated cost of $26,000.

**Moline, Ill.*—It is reported that Peter Peterson, 1209 12th Ave., has received the contract to erect a $50,000 office building for the Deere & Mansur Co.

**Davenport, Ia.*—The Tri-City Constr. Co., Masonic Temple, it is stated, has secured the contract to erect a 4-story, 150 x 160-ft. warehouse for Smith Bros. & Burdick. Temple, Burrows & McLane, McManus Bldg., are the Archts.

Montezuma, Ia.—It is stated that the citizens have voted in favor of erecting an opera house at a cost of about $10,000.

Des Moines, Ia.—E. T. Bennett, the coal dealer, it is stated, has purchased a site at 11th and Walnut Sts., and is having plans prepared for a 3-story building.

The officials of the Interurban Ry. Co. (F. S. Cummins, Ch. Engr., 607 Mulberry St.), it is stated, have accepted plans for the 2-story brick freight depot which is to be erected at 2d St. and Grand Ave.

Hallett & Rawson, 615 Walnut St., it is stated, are preparing plans for a 5-story warehouse which is to be erected at S. 9th and Tuttle Sts. for the Merchants' Transfer Co.

**Kansas City, Kan.*—F. A. Thompson, 630 Quindars Boule., it is reported, has received the contract to erect an opera house here at a cost of about $20,000.

Winchester, Ky.—It is reported that the Louisville & Nashville R. R. Co. has decided to erect a depot here at a cost of $16,000. Geo. E. Evans, Gen. Mgr., Nashville, Tenn.

**Louisville, Ky.*—Senden & Breck, of St. Louis, Mo., it is reported, have received the contract to erect the Louisville & Nashville R. R. Depot, at 10th St. and Bway.

Boston, Mass.—The plans of Brainerd & Leeds, 8 Beacon St., it is stated, have been accepted for 5-story and basement terra cotta and brick building for the Salvation Army, which is to be erected at Washington and E. Brookline Sts. It is stated that the cost, including ground, will be about $200,000.

*The Eastern Expanded Metal Co., 101 Tremont St., is reported to have secured the contract for constructing the automobile garage in Park Sq., for estate of E. D. Jordan. Architect, E. T. Barker, 5 Park Sq.

**Pittsfield, Mass.*—H. Neill Wilson, Archt., 24 North St., it is stated, has awarded the contract to erect a business block on North St. for Frank D. Taylor, to Osteyee Bros., 11 Cherry St., at about $30,000.

Westfield, Mass.—R. W. Wetherell is stated to have purchased property on Arnold St. and will convert it into a hotel.

Minneapolis, Minn.—J. W. Lindstrom, Andrus Bldg., it is reported, is preparing plans for remodeling the building at Hennepin Ave. and 7th St. Mrs. Alice Hall, owner. Estimated cost, $40,000.

**St. Paul, Minn.*—A permit has been issued for a 2-story brick building, to be used as a telephone office by the Tri-State Telephone Co. Contractor, C. N. Lovens, 984 E. Bayless Ave. Cost, $35,000.

*A permit has been issued for 3-story brick store and office building, to be erected on Minnesota St., between 5th and 6th Sts. Zimmermann Bros., owners. Olaf Swenson, contractor. Cost, $35,000.

**Jackson, Miss.*—McGee & Garber, of Jackson, have secured the contract for extension to N'orvello Hotel 2 stories, 122 rooms, brick, marble floor, refrigerating plant, for about $40,000. R. H. Hunt, of Chattanooga, Tenn., is Archt.

W. P. Tinsley, of Jackson, is preparing plans for 6-story brick store for Mrs. C. M. Mason, of Jackson, Miss.

**Houston, Miss.*—J. D. Williams, of Houston, it is reported, has received the contract to erect an opera house at a cost of about $30,000.

Kansas City, Mo.—J. O. Hogg, N. Y. Life Bldg., has prepared plans for a brick warehouse to be erected at Milwaukee Ave. and Central St., for the Moore Storage Co., to cost $40,000.

I. J. Hedrick will erect brick stores at 922-924 E. 12th St., to cost about $30,000.

St. Louis, Mo.—Bids will be received until Sept. 14 for erecting a modern fireproof building, 175 room capacity. Plans can be seen at the office of the Archt., Geo. R. Mann, Little Rock, Ark., or can be obtained from L. Ruckert, Laclede Bldg., St. Louis, after Aug. 15.

**Butte, Mont.*—E. H. Gagnon, of Billings, it is reported, has received the contract to erect a 4-story building, known as the Stapleton Blk., the cost reported to be about $100,000.

North Platte, Neb.—It is stated that bids will be received until Aug. 14 by George M. Graham, Sec'y, Temple Craft, for erecting a Masonic Temple at 5th and Dewey Sts. R. W. Grant, Archt, Beatrice, Neb.

Omaha, Neb.—A building permit has been granted to the S. D. Mercer Co., to erect a 5-story brick warehouse, 132 x 132 ft., at 11th and Howard Sts., at a cost of $57,000.

It is reported that improvements are to be made to the Hotel Miller at a cost of $20,000. Rome Miller, proprietor.

Rochester, N. Y.—The Rochester Ry. Co. is said to be considering the erection of a union trolley station at a cost of about $400,000.

**Charlotte, N. C.*—It is stated that J. E. Jones, of Charlotte, has secured the contract to erect the Highland Hotel, which is to be 6 stories, of brick and stone, and is to cost about $200,000.

**New Philadelphia, O.*—The Pittsburg Constr. Co., of Pittsburg, Pa., it is stated, has received the contract to erect the depot here for the Baltimore & Ohio R. R.

Toledo, O.—It is reported that J. H. Bellows will erect a $75,000 business building at Beach and Erie Sts.

Youngstown, O.—The Pennsylvania R. R. Co., it is stated, will erect a new depot here, if the city will assist in the building of a new bridge at Spring Common. W. F. Brown, Ch. Engr., Philadelphia, Pa.

**Tamaqua, Pa.*—The contract for the erection of the Elks' home at this place, it is reported, has been awarded to Andrew Breslin for $19,850.

**Philadelphia, Pa.*—The Chas. McCaul Co., 10 N. 11th St., it is stated, has secured the contract to erect an exchange building for the Bell Telephone Co., at Lancaster Ave. and Media St., which is to be a 2-story brick and terra cotta structure, 65 x 100 ft., and is to cost about $80,000.

It is reported that additions and alterations are to be made to the Union League Club House at Broad and Sansom Sts., at a cost of $500,000.

Reading, Pa.—Wm. A. Fink, of Reading, has prepared plans for a hotel, to be erected here for J. Basby, to cost about $15,000.

Pittsburg, Pa.—A site on St. Pierre St., Oakland, it is stated, has been purchased by the member of the University Club, and plans are now being prepared by MacClure & Spahr, Keystone Bldg., for a club house, which it is proposed erecting at a probable cost of $100,000.

Knoxville, Tenn.—A building permit has been granted to Thomas & Turner to erect a 3-story addition to the Henson Bldg., at a cost of $25,000. A permit has also been granted to Barber, Kluttz & Graf, Archts., 21 French St., to erect the Miller Bldg., at Gay St. and Union Ave., at a cost of $45,000; also to the Oliver Co., to erect a 4-story reinforced concrete steel building for Col. Jas. Vandeventer, at a cost of $25,000.

Chattanooga Tenn.—The Y. M. C. A. it is reported, has purchased a site in South Chattanooga and intends erecting a building at a cost of $40,000. C. W. Olson, Chmn.

Memphis, Tenn.—It is stated that A. B. Groves, of St. Louis, Mo., has been engaged to prepare plans for an 8-story office building which is to be erected at 2d and Jefferson Sts., at an estimated cost of $150,000.

**Staunton, Va.*—John Wilson, of Richmond, it is stated, has received the contract to erect the Chesapeake & Ohio R. R. depot in this city at a cost of about $30,000.

Prosser, Wash.—The plans of G. W. Bullard, of Tacoma, it is stated, have been accepted for the J. W. Carey block, which is to be erected at 7th St. and Stacy Ave. at a cost of $25,000.

Tacoma, Wash.—Chas. B. Hurley, it is stated, has taken out a permit to erect a 4-story concrete building at S. 13th and C Sts., to cost $23,000.

Spokane, Wash.—A building permit has been taken out by J. H. McAllister for a 3-story brick warehouse, to be erected at a cost of $20,000.

The Spokane Dry Goods Co., it is reported, will spend $25,000 in remodeling its building. J. M. Comstock, Mgr.

Aberdeen, Wash.—Reid & Bridges, it is stated, have prepared plans for a brick and stone building, to be erected on Heron St., and to be known as the Lumber Exchange.

Vancouver, Wash.—Robertson & Donnellan, of Seattle, it is stated, are preparing plans for a theatre which is to be erected here at a cost of $50,000.

Seattle, Wash.—Robertson & Donnellan, of Seattle, it is stated, have been commissioned to prepare plans for a 5-story annex to the Diller Hotel, which is to cost about $25,000. Mrs. Diller, owner.

Edw. F. Sweeney, Gen. Mgr. of the Seattle Brewing & Malting Co., it is stated, has taken out a permit to erect an 8-story building on 2d Ave., to be used as a hotel and office building, the cost to be about $110,000.

**Viroqua, Wis.*—J. W. Lake & Son, of Viroqua, have secured the contract to erect a tobacco warehouse here at about $16,125.

Toronto, Ont.—It is reported that the buildings of the Knickerbocker Ice Co. and the 5-story warehouse of the Granby Rubber Co., at the foot of Jarvis St., have been destroyed by fire.

NEW YORK, N. Y.

106 Mulberry St., 6-story br. and stone store and tenement; c, $45,000; o, John Palimeri; a, Edward A. Meyers.

53 W. 8th St., 7-story br. and stone store and office bldg.; c, $22,000; o, Louis Molia; a, Max Muller.

119 E. 19th St., 7-story br. and stone studio bldg.; c, $200,000; o, The Arts Realty Co.; a, Geo. B. Post & Sons.

119 W. 25th St., 11-story br. and stone store and loft bldg.; c, $200,000; o, Weiler & Knoche, a, G. Knoche.

31st St. and 2d Ave., 6-story br. and stone store and tenement; c, $35,000; o, L. Kidansky & Fox; a, Horenburger & Straub.

523 8th Ave., 6-story br. and stone store and loft bldg.; c, $70,000; o, Henry Gevershofer; a, S. B. Eisendrath & Horwitz.

82d St. and Ave. A., 6-story br. and stone store and tenement; c, $35,000; o, Saml Abrams; a, Horenburger & Straub.

Ave. A and 62d St., 2-story concrete and br. boiler house; c, $36,000; o, a and b, The Standard Gas Light Co.

Lexington Ave. and 101st St., 4 6-story br. and stone stores and tenements; total c, $216,000; o, Gruenstein & Mayer; a, E. H. Meyers.

110th St. and Lexington Ave., 6-story br. and stone store and tenement; c, $30,000; o, Morris S. Rachmil; a, Horenburger & Straub.

145th St. and 7th Ave., 5 6-story br. and stone stores and tenements; total c, $200,000; o, Times Realty & Constr. Co.; a, Neville & Bagge.

Elton Ave. and 160th St., 6-story br. store and tene-

**Items marked thus give the names of parties awarded contracts.*

ments; c, $55,000; o, Noble & Gauss Constr. Co.; a, Harry T. Howell.

Bway and 73d St., alterations to 17-story br. and stone apartment hotel; c, $100,000; o, W. E. D. Stokes; a, A. W. McCrea.

5th Ave. and 21st St., alterations to 11-story br. and stone bank bldg.; c, $50,000; o, The Hudson Realty Co.; a, Jacob & Heidelberg.
Fred. S. Schlesinger.

54 Lawrence St., 6-story br. and stone store and tenement; c, $50,000; o, Forward Realty & Constr. Co.; a,

593 7th Ave., 12-story br. and stone hotel; c, $300,000; o, Timothy F. Poddil; a, Robt. D. Kohn.

127th St. and Lexington Ave., 6-story br. and stone store and tenement; c, $36,000; o, M. L. Lowenhof; a, Benj. W. Levitan.

48 Beach St., 6-story br. and stone factory; c, $160,000; o, The Protestant Episcopal Society for Promoting Religion and Learning in State of N. Y.; a, Chas. C. Haight.

43 W. 13th St., 8-story br. and stone store and loft building; c, $100,000; o, Rothenberg & Co.; a, Louis Korn.

329 E. 14th St., 6-story br. and stone store and tenement; c, $25,000; o, Rosehill Realty Cor.; a, Horenburger & Straub.

331 E. 34th St., 6-story br. and stone store and tenement; c, $35,000; o, Voccoli & Brande; a, Horenburger & Straub.

218 E. 112th St., 2 6-story br. and stone store and tenement; c, $38,000; o, Jacob Levine; a, E. A. Meyers.

118th St. and 2d Ave., 2 6-story br. and stone stores and tenements; total c, $100,000; o, Raphael Kurzrok; a, Horenburger & Straub.

2d Ave. and 120th St., 6-story br. and stone store and tenement; c, $45,000; o, Wolf & Rothstein; a, Horenburger & Straub.

65th St. and Bway, 4-story br. and stone theatre; c, $175,000; o, Empire Realty Co.; a, J. B. McElfatrick & Son.

Bway and 62d St., 4-story br. and stone garage; c, $60,000; o, Island Realty Co.; a, Jay H. Morgan.

Manhattan Ave. and 108th St., 5 6-story br. and stone stores and tenements; total c, $264,000; o, The R. M. Silverman Realty & Constr. Co.; a, Geo. F. Pelham.

132d St. and 12th Ave., 2-story br. and stone boiler house; c, $26,000; o, a and b, The Standard Gas Light Co.

Amsterdam Ave. and 128th St., 5-story br. and stone storage bldg.; c, $125,000; o, Bernheimer & Schwartz; a, L. Oberlein.

Bway and 142d St., 6-story br. and stone store and tenement; c, $110,000; o, Knight & Dongan Constr. Co.; a, Neville & Bagge.

Bway and 55th St., alterations to 11-story br. and stone apartment hotel; c, $30,000; o, Henry Schwartzwalder; a, Maynicke & Franke.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

**Oregon, Ill.*—W. J. McAlpine, of Dixon, it is stated, has secured the contract to erect a residence here for Col. Frank O. Lowden, at a cost of about $60,000.

Chicago, Ill.—Addison C. Berry has prepared plans for the new church which is to be built at W. Jackson Boule. and 44th Ave., for the Garfield Park Baptist Congregation. It is to be of brick and stone with slate roof, and cost $25,000.

C. F. Sorenson, 648 N. Claremont Ave., has made plans for a church to be built at N. Fairfield Ave. and LeMoyne St., for the Swedish Evangelical Lutheran Mission. The building will be a brick structure, 47 x 97 ft., and cost $20,000.

A 3-story apartment building is to be built at 6809-11 Union Ave. for A. H. Wilson. A. G. Ferree, Archt., 6452 Union Ave. It will be 50 x 65 ft., and cost $25,000.

J. S. Flizikowsky, 1059 N. 41st St., has prepared plans for a 4-story flat, 44 x 137 ft., to be erected at N. Ashland Ave. and Blackhawk St., for Paul Ratkowsky, at a cost of $25,000.

Penfield, Ill.—The Roman Catholics, it is reported, intend erecting a $25,000 edifice. Rev. J. F. Purcell, Pastor.

New Orleans, La.—It is stated that the members of the First Baptist Church contemplate erecting a $45,000 edifice.

Fairhaven, Mass.—Louis G. Destremps & Son, of Fall River, are preparing plans for a chapel for the Sacred Heart Congregation of Belgium; probable cost, $15,000.

Duluth, Minn.—The Directors of the Forrest Hill Cemetery (W. B. Paton, Pres.), it is stated, will erect a vault and chapel to cost about $25,000.

Kansas City, Mo.—J. W. McKecknie, N. Y. Life Bldg., has prepared plans for apartments to be erected on Armour Boule., for N. M. Daniels, to cost $55,000.

**Chappaqua N. Y.*—The Bridgeport Bldg. Co., of Bridgeport, Conn., it is reported, has received the contract to erect a $50,000 residence here for Victor Gunzburg, of the Empire Rubber Co., of N. Y. City. The contracts for the heating and plumbing to be let separately.

Merion, Pa.—Walter F. Price, of Philadelphia, it is stated, has prepared plans for a 3-story stone residence, which is to be erected by J. Alexander Simpson, Jr., at Merion.

Pittsburg, Pa.—Emmett Queen, of Guffey & Queen, oil producers, it is stated, is having plans prepared by Alden & Harlow, Farmers' Bank Bldg., Pittsburg, for an $80,000 residence, to be erected in Ellsworth Ave. near Morewood Ave. Shadyside.

A building permit has been granted to the Hamilton Ave. United Presbyterian Church, to erect a 2-story brick edifice at Homewood Ave. and Idlewild St., at a cost of $35,000, and to Mrs. Anna R. D. Gillespie, to erect a 2-story and attic brick dwelling on Ambrose St. and 5th Ave., at a cost of $35,000.

Reading, Pa.—A. Smith, Baer Bldg., is reported to be preparing plans for a stone tower to the front of the Lutheran Church, to cost about $20,000. Rev. Mr. Kerwin, D. D., Pastor.

Ft. Worth, Tex.—Plans for a $17,000 edifice for the congregation of the First Congregation Church have been prepared by F. E. Kidder, Denver, Colo.

Terrell, Tex.—It is reported that bids will be received until Aug. 8 for erecting an edifice for the Episcopal Congregation. Address, Rev. H. W. Robinson, Rector.

Madison, Wis.—The congregation of the German Lutheran Church, it is reported, has accepted the plans of Claude & Starck, Badger Blk., for an edifice which it is proposed erecting at a cost of $16,000. Address Pastor.

New York, N. Y.

Spring and Elm Sts., 6-story br. and stone tenement; c, $50,000; o, Abbate & Alvino; a, Bernstein & Bernstein.

30th St. and 2d Ave., 6-story br. and stone tenement; c, $40,000; o, Shearer, Emerson & Appleton; a, Lord & Hewlett.

330 E. 65th St., 3 6-story br. and stone tenements; total c, $114,000; o, Binder & Baum; a, Bernstein & Bernstein.

112th St. and 3d Ave., 6-story br. and stone tenement; c, $48,000; o, D. Gordon; a, Edw. A. Meyers.

433 E. 119th St., 2 6-story br. and stone tenement; c, $74,000; o, Empire Cornice Works; a, Bernstein & Bernstein.

322 E. 121st St., 6-story br. and stone tenement; c, $42,000; o, Abraham Levy; a, E. A. Meyers.

134th St. and Amsterdam Ave., 7 5-story br. and stone tenements; total c, $280,000; o, Burlington Realty & Constr. Co.; a, S. Sass.

135th St. and Riverside Drive, 2 5-story br. and stone tenements; total c, $100,000; o, J. V. Signall Co.; a, Neville & Bagge.

136th St. and 7th Ave., 6-story br. and stone tenement; c, $45,000; o, Philip and Irving Simon; a, E. A. Meyers.

136th St. and 5th Ave., 5 6-story br. and stone tenements; total c, $175,000; o, P. Ronginsky; a, Benj. W. Levitan.

138th St. and Amsterdam Ave., 5 5-story br. and stone tenements; total c, $200,000; o, Levy & Weinstein; a, B. W. Levitan.

140th St. and 7th Ave., 15 6-story br. and stone tenements; total c, $600,000; o, Harris & Abraham Cohen; a, Eugene J. Stern.

140th St. and Bway, 2 5-story br. and stone tenements; total c, $90,000; o, Saml. Hyams; a, L. F. J. Weiher.

Pleasant Ave. and 117th St., 2 6-story br. and stone tenements; c, $86,000; o, Saml. Lipman; a, Edw. A. Meyers.

123d St. and Amsterdam Ave., 6-story br. and stone tenement; c, $60,000; o, Pickelner Bros.; a Rouse & Sloan.

Central Park West and 70th St., 12-story br. and stone tenement; c, $800,000; o, Vailima Realty Co.; a, Robt. T. Lyons.

158th St. and Bway, 5-story br. and stone tenement; c, $42,000; o, Kuhn & Lawson; a, J. C. Cocker.

164th St. and Amsterdam Ave., 6-story br. and stone tenement; c, $50,000; o, Henry T. Beehman; a, Neville & Bagge.

184th St. and St. Nicholas Ave., 4 5-story br. and stone tenements; total c, $160,000; o, Hogenauer & Wesslau; a, Moore & Landsiedel.

St. Nicholas Pl. and 150th St., 2 5-story br. and stone tenements; total c, $84,000; o, Alex. Cameron; a, J. C. Cocker.

Jennings St. and Wilkins Pl., 2 5-story br. tenements; total c, $77,000; o, Benj. Berger; a, Geo. F. Pelham.

194th St. and Marion Ave., 5-story br. tenement; c, $20,000; o, Wm. H. Wright; a, M. J. Garvin.

Beekman Ave. and 141st St., 3 5-story br. tenements; total c, $90,000; o, Moses & Arndstein; a, M. J. Garvin.

Southern Boule. and 135th St., 4 5-story br. tenements; total c, $163,000; o, Abraham M. Morgenroth; a, Schneider & Herter.

Jennings St. and Southern Boule., 5 6-story tenements; total c, $300,000; o, Woelfinger & Zimet; a, Moore & Landsiedel.

St. John's Ave. and Southern Boule., 9 6-story br. tenements; total c, $540,000; o, Wm. Wainwright; a, Moore & Landsiedel.

Tinton Ave. and 163d St., 2 6-story br. tenements; total c, $90,000; o, Louis Weinstein; a, Rouse Sloan.

11 E. 66th St., 4-story br. and stone extension to 4-story br. and stone residence; c, $30,000; o, Adelaide E. Baylis; a, C. P. H. Gilbert.

232 Elizabeth St., 6-story br. and stone tenement; c, $42,000; o, Maria Ghiglione; a, Nathan Langer.

11 W. 57th St., 5-story br. and stone residence; c, $60,000; o, Augustus D. Juilliard; a, Trowbridge & Livingston.

323 E. 62d St., 6-story br. and stone tenement; c, $40,000; o, Possman & Seplow; a, W. C. Sommerfield.

536 E. 82d St., 6-story br. and stone tenement; c, $40,000; o, Louis Weinstein; a, Rouse & Sloan.

119th St. and Pleasant Ave., 6-story br. and stone tenement; c, $50,000; o, Greenberg & Berliner; a Bernstein & Bernstein.

2d Ave. and 113th St., 2 6-story br. and stone tenements; total c, $80,000; o, Hyman Romm; a, M. Zipkes.

115 W. 125th St., 2 5-story br. and stone tenements; total c, $78,000; o, estate of Eliza M. Bailey; a, Thos. Nash.

110th St. and 7th Ave., 6-story br. and stone tenement; c, $85,000; o, Jos. Oussani; a, Henry Anderson.

123d St. and 7th Ave., 6-story br. and stone tenement; c, $55,000; o, Hirsch & Williams; a, Geo. F. Pelham.

137th St. and Riverside Drive, 2 6-story br. and stone tenements; total c, $180,000; o, Cathedral Parkway Realty Co.; a, Louis C. Maurer.

174th St. and Wadsworth Ave., 2 5-story br. and stone tenements; total c, $125,000; o, Edw. Ossermann; a, Moore & Landsiedel.

182d St. and Audubon Ave., 5-story br. and stone tenement; c, $50,000; o, Dr. D. A. De Woltoff; a, B. W. Levitan.

Amsterdam Ave. and 163d St., 3 5-story br. and stone tenements; total c, $150,000; o, Middleboro Realty Co.; a, Oscar Lowinson.

185th St. and Park Ave., 5-story br. tenement; c, $45,000; o, The Bassford Realty Co.; a, J. J. Vreeland.

Washington Ave. and 173d St., 2 5-story br. tenements; total c, $120,000; o, Urry Goodman; a, Edw. A. Myers.

32 Park Ave., 1-story extension to 5-story br. and stone dwell.; c, $50,000; o, Harry Harkness Flagler; a, Little & O'Connor.

SCHOOLS.

Notes Arranged Alphabetically by States.

Fayetteville, Ark.—The Bd. of Trus. of the Univ. of Arkansas, it is stated, has engaged Thompson & Gates, of Little Rock, to prepare plans for the 2 dormitories and the chemical building, to cost in the aggregate about $65,000, and Heckenlively & Read, of Springfield, Mo., to prepare plans for the dairy, agricultural and infirmary buildings, the total cost of which is to be about $18,000. J. N. Tillman is Pres. Bldg. Com.

San Diego, Cal.—The citizens voted on July 27 in favor of issuing $135,000 bonds for the purpose of erecting a high school.

Denver, Colo.—Simon Guggenheim, it is stated, has given $75,000 to the Colorado School of Mines, which is to be used to erect an administration building which is to be known as Simon Guggenheim Hall. E. C. Alderson, Pres. Bd. Regents.

Golden, Colo.—It is stated that the Colorado State School of Mines has received a donation of $25,000 for the erection of an additional building.

Washington, D. C.—The following are the bids opened on July 29 by the Comrs. D. C., for constructing buildings for the Industrial Home School at Bellevue: J. Pavaroni, $59,900; cottages, $12,000 each, and Gleason & Humphrey, $61,000; cottages, $12,300 each.

Athens, Ga.—Plans have been prepared by Haralson Bleckley, of Atlanta, for the Y. M. C. A. Bldg., which it is proposed erecting at the Univ. of Georgia, the cost to be about $75,000.

**Macomb, Ill.*—The contract for the erection of the Western Illinois State Normal School, it is reported, has been awarded to the Tri-City Constr. Co., of Davenport, at $110,000.

Indianapolis, Ind.—It is reported that bids will be received until Aug. 8 by John E. Cleland, Bus. Mgr. School Bd., for installing within one general contract the plumbing, water heater, marble and wood partitions, etc., for the shower baths, lockers and gymnasium of the new Shortridge High School; also for covering steam pipes in new building and annex to old building.

Bloomington, Ind.—It is stated that bids will be received until Aug. 16 for erecting a library at the Univ. of Indiana. Patton & Miller, Archts., Chicago, Ill.

**Springfield, Mass.*—Contracts for erecting the school in Ward 3 (bids opened July 14 by the Bd. of Pub. Wks.), have been awarded as follows: General construction, J. Shea & Son, $38,930; ventilating and heating, Hawes & Gray, $4,735, and plumbing, Donohue Bros., $3,155. Contractors all of Springfield.

**Detroit, Mich.*—It is stated that contracts have been awarded for erecting the Ellen E. Capron School, at Maple and Ripolle Sts., as follows, Malcomson & Higginbotham, Archts., Moffat Bldg.: Carpenter and joiner, Harcus & Lang, $15,560; mason, P. H. Goddard, $13,230; iron work, H. B. Lewis, $1,829; cut stone, Wm. S. Piggins, $2,227; slate and sheet metal, A. J. Orth, $2,412; plumbing, John F. Jones, $1,895; plastering, J. H. Laurie, $3,150; heating and ventilating, Jas. Partlan, $6,585; heat regulation, Johnson Co., $900; stokers, Detroit Stoker & Fdy. Co., $645; electric wiring, Miller-Selden Co., $508.

Holland, Mich.—A Carnegie gymnasium is to be erected at Hope College at a cost of about $20,000.

Grindstone City, Mich.—Bids will be received until Aug. 15 by the Bd. Educ. (Wm. B. Smith, Secy.) for erecting a 2-story and basement brick school; White & Hussey, Archts., 420 Hollister Bldg., Lansing.

Ann Arbor, Mich.—The Alumni Assoc., it is stated, has $100,000 with which it proposes erecting a memorial building at the Univ. of Michigan. Pres. Angell, of the Bd. of Regents, it is stated, has been authorized to appoint a committee of 3 to act with the Alumni Com., to consider plans for the proposed building.

Minneapolis, Minn.—Thos. Shevlin, of Minneapolis, it is stated, has given $60,000 to the Univ. of Minnesota, with which to erect a woman's building.

St. Louis, Mo.—Geo. W. Hellmuth, 721 Olive St., it is stated, will prepare plans for a new building for the academy of the Sisters of the Visitation, which is now on Washington Boule.

**Seward, Neb.*—Wm. Worthman, Sr., it is stated, has secured the contract to erect the 3-story brick dormitory at the German Lutheran College at about $27,000.

**Ocean City, N. J.*—Jos. Steelman & Co., it is reported, have received the contract to erect the high school at about $40,000.

New York, N. Y.—Plans have been filed for a 5-story brick and stone school, to be erected at 77th St. and Ave A, at a cost of $50,000, for the City of New York. C. B. J. Snyder, Archt., 500 Park Ave.

*The following are the bids opened July 31 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for installing ventilating and heating apparatus, (*a*) School No. 64, Manhattan Boro.; (*b*) Erasmus Hall High School, Brooklyn Boro.: Rossman & Bracken Co., 132 E. 42d St., N. Y. City, *a* $39,100; *b* $22,500 (awarded contract). Blake & Williams, *a* $39,322. Evans, Almirall & Co., *a* $41,376; *b* $22,986. Jas. Curran Mfg. Co., *a* $39,494; *b* $23,716. Dowdeswell Bros., *a* $41,339; *b* $23,687; Walker & Chambers, *a* $39,975; *b* $22,965. United Htg. Co., *a* $39,600; *b* $25,721. E. Rutzler Co., 178 Centre St., N. Y. City, *a* $38,755 (awarded contract); *b* $22,841.

*Bids were opened same time and place for sanitary work and gas fitting for Erasmus Hall High School, Brooklyn Boro.: Jas. Harley, $21,187; Dowdeswell Bros., $26,320; Leonard D. Hosford, 68 Beekman St., N. Y. City, $17,698 (awarded contract); Rossman & Bracken Co., $23,600, and Frank J. Fee, $26,520.

*Bids were opened same time and place for general construction of addition to and alterations in Public School 29, Queens Boro.: Richard H. Carman, $27,400, and Chas. Wille, 39 E. 42d St., N. Y. City, $25,569 (awarded contract).

*Bids were opened same time and place for alterations to ventilating and heating apparatus: (*a*) School 52, Manhattan Boro.; (*b*) School 29, Queens Boro.; (*c*) School 30, Queens Boro.: Rossman & Bracken Co., *a* $6,300; *b* $5,500; *c* $4,900. E. Rutzler Co., 178 Centre St., N. Y. City, *a* $6,089 (awarded contract); *b* $4,863. Evans, Almirall & Co., *a* $6,567; *b* $5,747; *c* $4,717. Harry L. Philp, *a* $6,663. United Htg. Co., 174 Wooster St., N. Y. City, *b* $4,700 (awarded contract); *c* $4,621. Isaac B. Merritt, Whitestone, L. I., *c* $4,370 (awarded contract).

Bids will be received until Aug. 14 by C. B. J. Snyder, Supt. School Bldgs., for the general construction, etc., of a temporary school in the rear of School No. 45, Boro. Brooklyn, for the general construction, etc., of alterations of School No. 53, the general construction of School No. 90, erecting outside iron stars at School No. 41, installing ventilating and heating apparatus in temporary School Bldg. No. 8, alterations and repairs to Hall of the Bd. of Educ., at 59th St. and Park Ave., all in the Boro. of Manhattan; also for the general construction, etc., of School No. 1 in the Boro. of Richmond.

**Long Island City, L. I., N. Y.*—The following are the bids opened on July 24 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for installing, ventilating and heating apparatus of addition to and alterations in School 4, Boro. of Queens: E. Rutzler Co., $36,000; Frank Dobson, $36,541; Rossman & Bracken Co., 132 E. 42d St.,

**Items marked thus give the names of parties awarded contracts.*

N. Y. City, $32,150 (awarded contract); Dowdeswell Bros., $35,479; Walker & Chambers, $33,935; United Htg. Co., $35,361.

Troy, N. Y.—Lawlor & Haase, 69 Wall St., New York, are preparing plans for a chemical laboratory for the Rensselaer Polytechnic Institute. It will be 4 stories high, 83 x 83 ft., fireproof, and cost $80,000.

*Andrew J. Robinson, of N. Y. City, it is stated, has secured the contract to erect the Carnegie Hall on the Warren property, east of 8th St., for the Rensselaer Polytechnic Inst., at an approximate cost of $119,000.

Ithaca, N. Y.—Bids will be received by E. L. Williams, Treas. Cornell Univ., until Aug. 21, for boilers, heating, plumbing and gas piping, electric wiring and fixtures, for the N. Y. State College of Agriculture, at Cornell University, as advertised in The Engineering Record.

Fargo, N. D.—Hancock Bros., of Fargo, it is stated, are preparing plans for a $30,000 music and science hall, which is to be erected at Fargo College.

Lakewood, O.—Bids will be received until Aug. 29 by the Bd. Educ. (O. C. Muehlhauser, Clk.) for erecting an addition to the West School. Bids on material and labor to be submitted separately. L. W. Thomas, Archt., 262 Prospect St., Cleveland.

**Tonkawa, Okla. Ter.*—It is stated that the following are the bids received July 15 by the Bd. Regents for erecting a building at the Tonkawa Preparatory School at Tonkawa; L. F. Lee, Oklahoma City, $55,922 (awarded contract); H. C. Snyder and J. H. Billings, Guthrie, $66,478; W. S. Sherman & Co., Guthrie, $61,578; O. F. Keck, Ponca City, $68,600, and A. O. Campbell, Oklahoma City, $62,929.

**Philadelphia, Pa.*—A building permit has been granted to Wm. Dougherty, 1604 Sansom St., to erect a 4-story dormitory at the Univ. of Pennsylvania, at a cost of about $40,000. Cope & Stewardson, 320 Walnut St., are the Archts.

**Memphis, Tenn.*—The following are reported to be the bids received for erecting 2 schools, (*a*) price on one building; (*b*) total cost of both buildings: R. F. Creson, *a* $28,670; Oleson & Lesch, *b* $60,000; A. W. Gettingby, *b* $57,759; E. J. Wagner, *b* $60,820; Fred. B. Young, 1219 Mississippi Ave., *a* $27,245 (awarded contract).

Greenfield, Wis.—The plans of Chas. L. Lesser 331 Grove St., Milwaukee, it is stated, have been accepted for a $30,000 school, to be erected by School Dist. No. 5 in the town of Greenfield.

Poynette, Wis.—It is stated that the School Bd. has decided to erect a $25,000 school.

La Crosse, Wis.—It is stated that Dwinnell & Laughlin, of Waukesha, submitted the lowest bid for erecting the high school, not including plumbing, heating and wiring, at $125,000.

West Allis, Wis.—It is reported that plans are being completed for a $30,000 school.

Appleton, Wis.—It is stated that all bids recently received for erecting the Carnegie Library at the Lawrence Univ., have been rejected. Van Ryn & Degellecke, Archts., Milwaukee.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

New London, Conn.—The matter of constructing a garbage crematory for this city is in the hands of a committee, which will report to Council Aug. 7. Dr. F. J. Beckwith, Health Officer.

Steubenville, O.—Frank S. King, City Aud., writes that an ordinance has been passed, providing for the issue of $15,000 bonds for the construction of a garbage crematory, but the bonds have not yet been sold. S. B. Curfman, City Engr.

**Panama.*—Louis McKetchin, of Chicago, has secured the contract for furnishing a destructor at Bas Obispo for $1,791 (bids opened July 24 by the Isthmian Canal Comn. at Washington, D. C.).

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

American Locomotive Co. will shortly begin erecting at Providence, R. I., a 3-story, fire-proof structure, measuring 65 x 335 ft., to be used for the manufacture of automobiles. A large quantity of machinery will be installed.

Morgan Spring Co., Worcester, Mass., will shortly install a rolling mill plant.

Mr. John A. Cruikshank, Bellefontaine, O., vice-president of the Union Portland Cement Co., Rushsylvania, O., and of the American Portland Cement Co., Neodesha, Kan., is organizing a company to manufacture Portland cement near New Orleans, La.

Schwarzschild & Sulzberger Co. is preparing plans for a 70 x 130 ft. 7-story canning room, to be erected at its Kansas City plant. Sausage room and lard refinery at that point recently destroyed by fire, will be rebuilt. The Chicago branch of this concern is in the market for two 400 hp. boilers, an 8 x 250 ft. self-sustaining steel stack, and a 300-ton ice machine, together with condensers and brine coolers.

The Windham Silk Co., Willimantic, Conn., has purchased land on which they will shortly erect a 2-story, 280 x 86 ft. mill building. About 100 hp. will be required for operating the plant. Lighting plant will also be installed.

Penn Bridge Co., Beaver Falls, Pa., is preparing plans for an extensive new plant, according to local newspaper reports.

The C. T. Williamson Co., Newark, N. J., mfrs. of wire novelties, will shortly begin the erection of a new plant, to cost about $25,000, according to local newspaper reports.

Niagara Cement Co., Buffalo, N. Y., recently incorporated, will erect a $100,000 plant, according to local newspaper reports.

Dodd & Strothers Co., Des Moines, Ia., mfrs. lightning rods and electrical appliances, will make extensive additions to its plant, according to local newspaper reports.

Crompton-Thayer Loom Co., Worcester, Mass., will make extensive additions to its present plant, according to local newspaper reports.

National Self-Winding Clock Co., Champaign, Ill., has purchased site for an extensive plant, according to local newspaper reports.

The North American Mfg. Co., East Liverpool, O., will shortly begin the erection of a thirty-kiln pottery, at Newell, W. Va. The plant will consist of three 1-story, one 5-story and one 3-story buildings, each 600 ft. long.

Lombard Iron & Supply Co., Atlanta, Ga., is building an extensive addition to its plant, and is in the market for a 20-ton electric or pneumatic crane and electric generators.

Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., is building an addition to its plant, which will be of brick and steel construction, 96 x 96 ft. and 2 stories high. Complete automatic sprinkling system will be installed.

The Barlow & Kent Co., Urbana, O., is rebuilding its plant No. 2, recently destroyed by fire. The new building will be of brick and iron construction, with concrete floors, and will measure 40 x 225 ft. New machinery will be required.

National Rice Milling Co. will erect a modern elevator at New Orleans, La., for the handling of rough rice, together with large storage facilities for by-products, the whole to cost $85,000, according to newspaper reports.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

Oakland, Cal.—Bids will be received at the office of the U. S. Engineer, Flood Bldg., San Francisco, until Sept. 5, for dredging in Oakland Harbor, Cal., as advertised in The Engineering Record.

New London, Conn.—Bids will be received by Lieut. Col. C. F. Powell, Corps Engrs., U. S. A., until Aug. 26, for dredging in West River, from New Haven Harbor, Conn., as advertised in The Engineering Record.

Cripple Creek, Colo.—A. C. Jaquith, Engr. Cripple Creek Drainage Tunnel Co., writes that the proposed drainage tunnel will cost $1,000,000. Date of letting of contracts undecided.

Washington, D. C.—See "Water."

Washington, D. C.—Col. Chas. S. Bromwell, Supt. Bldgs. and Grounds, in his report to the War Dept., estimates the cost of improving and the care of public grounds for the next fiscal year at $175,210; $40,000 for rebuilding the sea wall on Potomac River; $50,000 for the construction of a macadam roadway on the north and west sides of the tidal reservoir in Potomac Park, and $13,000 for completing the improvement of the grounds of Mt. Vernon Square, around the new public library.

*On the recommendation of Col. Bromwell, Supt. of Pub. Bldgs. and Grounds, Gen. Mackenzie, Ch. of Engrs., is reported to have awarded contracts for about 7,800 tons broken stone for use in the construction of roadways in Potomac Park, between the causeway of the Pennsylvania Ry. Bridge, the Potomac River and the tidal reservoir, as follows: To Chas. G. Smith, for 4,000 tons of gneiss at $1.37½ per ton, or $5,500; to the B. F. Pope Stone Co., 3,300 tons of trap rock at $1.85 per ton, or $6,105; to the Grove Lime & Coal Co., 500 tons of limestone at $1.53 per ton, or $765, making a grand total of $13,370.

Augusta, Ga.—Col. Jas. B. Quinn, Corps Engrs., U. S. A., of Savannah, in his annual report is stated to have recommended an appropriation of $70,000 for the completion of projected work at Augusta, in the way of jetties, widening the channel, etc.

Savannah, Ga.—See "Business Buildings."

Chicago, Ill.—The lowest bid received and opened on July 25 by Lieut. Col. Wm. H. Bixby, Corps Engrs., U. S. A., for dredging in Chicago River, was submitted by the Great Lakes Dredge & Dock Co., of Chicago, 857,143 cu. yds., at 10.5 cts. per cu. yd.

Albion, Ind.—It is reported that plans are being prepared for dredging Elkhart River and its branches in Noble County. These and collateral ditches will include about 40 miles of ditch work.

Greenfield, Ind.—Oliver Monger, County Engr., is reported to be making plans for dredging and straightening Brandywine Creek and cutting collateral ditches.

Indianapolis, Ind.—It is reported that the Bd. of Pub. Wks. is receiving bids for the construction of a subway under the tracks of the Big Four R. R. at Valley Ave.

South Bend, Ind—It is stated that bids will be received until Aug. 9, Titus E. Kinzie, Constr. Comr., for constructing a ditch requiring 30,890 cu. yds. dredge work in main ditch and 13,450 cu. yds. to be excavated for laterals.

Chanute, Kan.—It is reported that negotiations have been completed in Pittsburg, Pa., by the Melon Bros., the Cudahys and the Shell Transportation Co., for financing the proposed pipe line to the Gulf of Mexico with the Union Trust Co., of Pittsburg, Pa. The pipe line will extend from Chanute to Port Arthur, 650 miles, and will cost about $6,000,000.

Richmond, Ky.—The following are the bids opened on July 21 by Lieut.-Col. E. H. Ruffner, Corps Engrs. U. S. A., Cincinnati, O., for furnishing about 14,000 bbl. American Portland cement, at Richmond, Ky., for use at Lock No. 11, Kentucky River (*a*) brand, (*b*) price per bbl. in bbls., (*c*) price per bbl. in bags, (10 cts. to be deducted for each empty bag returned): Alpha Portland Cement Co., Easton, Pa., *a* Alpha, *b* $2.10, *c* $2.11; Virginia Portland Cement Co., New York, N. Y., *a* Old Dominion, *b* $1.89, *c* $1.97; Marquette Cement Mfg. Co., Chicago, Ill., *a* Marquette, *b* $2.26, *c* $2.31; Hutchinson Cement Co., New York, N. Y., *a* Whitehall, *b* $2.23, *c* $2.28; Vulcanite Portland Cement Co., New York, N. Y., *a* Vulcanite, *b* $2.25, *c* $2.25; Atlas Portland Cement Co., New York, N. Y., *a* Atlas, *c* $2.08.

**New Orleans, La.*—The following are the bids opened on July 12 by Capt. J. F. McIndoe, Corps Engrs., U. S. A., for dredging at mouths of Amite River and Bayou Manchac, 25,000 cu. yds., price given per cu. yd.: J. H. Gardner Constr. Co., New Orleans, 40 cts., and Jahncke Navigation & Improv. Co., New Orleans, 25 cts. (awarded contract).

The only bid received and opened on July 29 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for filling and grading at the Naval Station, New Orleans, was submitted by John F. McCoy, 1433 Melpomene St., New Orleans; he bid 55 cts. per cu. yd. for filling, according to plans, and 85 cts. per cu. yd. if material is obtained by dredging. Funds available for this work, $35,000.

Portland, Me.—Bids will be received until Aug. 31 by Lieut. Col. W. M. Black, Corps Engrs., U. S. A., for dredging in Kennebec River, as advertised in The Engineering Record.

**Boston, Mass.*—Thomas & Connor, of Middleboro, have secured the contract for constructing an outlet for Herring River at Harwich (bids opened July 27 by the Harbor and Land Comrs.) at $2.23 per ton for stone, furnished and placed in jetties, and in riprap on banks of channel, and 28 cts. per cu. yd. for excav. new channel and building dike.

Detroit, Mich.—Maj. Lansing H. Beach, Corps Engrs., U. S. A., in his annual report, is stated to have recommended the continuing of Harbor Beach, harbor of refuge, at a cost of $300,000, and for new light stations and improvements to old ones, $311,700.

Trenton, N. J.—Prof. Lewis Haupt, of Philadelphia, Pa., is reported to be making a survey of the New Jersey coast line, for the State Geological Survey, with a view to suggesting improvements to inlets and harbors.

Newark, N. J.—Bids will be received until Aug. 15 by the Essex County Park Comn. (A. Church, Secy.) for the construction of concrete foundations, coursed rubble masonry and the furnishing and setting of bluestone steps, coping, etc., in Branch Brook Park, West Side Park, Orange Park and Watsessing Park, Essex County, as advertised in The Engineering Record.

**New York, N. Y.*—The following are the bids opened on July 28 by the Dept. of Docks and Ferries for (*a*) 20,000 cu. ft. headers and stretchers, (*b*) 7,000 cu. ft., coping stone: Matthew Baird Constr. Co., 433 E. 92d St., *a* $1.08, *b* $1.22; M. McGrath Co., 81st St. and East River, *a* $1.10, *b* $1.24; Booth Bros. & H. I. Granite Co., 207 Broadway, *a* $1.09, *b* $1.29; The Chase Granite Co., 11 Broadway, *a* $1.08, *b* $1.20; John Peirce Co., 277 Broadway, *a* 95 cts., *b*. $1.12½; total, $26,875. (Awarded contract.)

New York, N. Y.—The only bid received and opened on July 31 by C. B. J. Snyder, Supt. School Bldgs., for installing electric elevators in De Witt Clinton High School, was submitted by the Marine Engine & Machine Co., of New York, for $12,633.

New York, N. Y.—Bids will be received until Aug. 17 by the Comrs. of Parks (John J. Pallas, Pres.) for furnishing material and erecting a flight of steps at the Zoological Park, Bronx Park; also for furnishing 3,000 cu. yds. broken stone of trap rock and 1,500 cu. yds screenings of trap for the Botanical Garden, Boro. Bronx.

Brooklyn, N. Y.—Bids will be received until Aug. 10 by the Park Bd., New York City (John J. Pallas, Pres.) for furnishing material and erecting an Ohio sandstone wall on a concrete foundation along a portion of Prospect Park West, Boro. Brooklyn.

Middletown, N. Y.—Bids will be received until Aug. 14 by the Common Council (Robt. Lawrence, Pres.), for furnishing material and constructing a brick conduit along the line of the Draper Brook, across Cottage St.

Lorain, O.—Press reports state that contracts are about to be let by the American Shipbuilding Co. (R. C. Wetmore, Secy.) for a dry dock, 775 x 125 ft., to be erected at Lorain, to cost about $300,000. Other improvements contemplated by the company include the doubling of the present shop capacity, the lengthening of two slips of the company and the construction of 2 additional slips; total cost of improvements proposed, reported to be about $2,000,000.

Panama.—Bids will be received until Aug. 28 by the Isthmian Canal Comn. (D. W. Ross, Purchasing Agt.), Washington, D. C., for furnishing sanitary fixtures at Panama.

Pittsburg, Pa.—Two bids were received and opened on July 21 by Maj. Wm. L. Sibert, Corps Engrs., U. S. A., for furnishing and installing compressed air machinery for new Lock 2, Monongahela River: Dravo, Doyle & Co., of Pittsburg, submitted 4 bids, prices ranging from $13,716 to $16,862, according to make of air compressor, and Reisinger-Prather Co., Pittsburg, 5 bids, $16,526 to $19,960.

Pittsburg, Pa.—The following are the totals of bids opened on July 31 by Maj. Wm. L. Sibert, Corps Engrs., U. S. A., for constructing steel lock gates on Ohio River, (*a*) 2 lock gates at Lock No. 2 (*b*) 2 lock gates at Lock No. 3, (*c*) 2 lock gates at Lock No. 4, (*d*) 2 lock gates at Lock No. 5: New Jersey Bridge Co., Manasquan, N. J., *a*, *b*, *c* and *d*, each, $40,230; Penn Bridge Co., Beaver Falls, *a*, *c* and *d*, each, $37,936, *b* $39,316; Lawrence D. Weaning, Cleveland, O., *b* $38,326.

The detail bids on 2 locks at Lock No. 3 were as follows, (1) N. J. Bridge Co., (2) Penn Bridge Co., (3) Lawrence D. Weaning:

	(1)	(2)	(3)
14 M. ft. timber	$75.00	$59.00	$65.00
4,000 lb. bronze	.75	.33	.38
48,000 lb. cast iron	.05	.06	.059
16,000 lb. steel castings	.11	.09	.084
460,000 lb. wrought steel (including all material except as above)	.067	.07	.067
Painting iron work of 2 gates	1,200.00	650.00	900.00

Newport, R I.—Bids will be received until Aug. 30 by Lieut. Col. J. H. Willard, Corps Engrs., U. S. A., for constructing extensions to shore arm of breakwater at Point Judith, as advertised in The Engineering Record.

Nashville, Tenn.—Bids will be received by Maj. H. C. Newcomer, Corps Engrs., U. S. A., Nashville, until Aug. 31, for building concrete lock and dam No. 21, Cumberland River, as advertised in The Engineering Record.

Seattle, Wash.—Bids will be received until Aug. 19 by Maj. John Millis, Corps Engrs., U. S. A., for dredging Grays Harbor and Chehallis River, Wash.

Olympia, Wash.—This city is reported to have a 225-acre tract of land which it proposes converting into a public park, and has selected E. R. Roberts, Supt. of the City Parks, Tacoma, to supervise the landscape work.

Bremerton, Wash.—The following are the bids opened on July 29 by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for removing about 65,000 cu. yds. of material from waters of navy yard, Puget Sound: (*a*) price per cu. yd., (*b*) total: North American Dredging Co., 95 Market St., San Francisco, Cal., *a* 46.5 cts.; *b* $30,225. Puget Sound Bridge & Dredging Co. 95 Yesler

**Items marked thus give the names of parties awarded contracts.*

Way; Seattle, *a* 39.8 cts.; *b* $25,870. International Contr. Co., 737 N. Y. Blk., Seattle, *a* 44 cts.

Milwaukee, Wis.—A correspondent writes that it is proposed to straighten the channel of Kinnickinnic River, and also construct several turning basins.

PROPOSALS OPEN

For Proposals see pages 80, 84, 85, 87, 88 AND 89

WATER WORKS.

Bids Close.		See Eng. Record.
Aug. 8.	Water works, Columbia, S. C. Adv. Jul. 1, 8, 22.	Jul. 1
Aug. 8.	Pipe, etc., Cincinnati, O.	Jul. 22
Aug. 8.	Water wks., Hammond, La.	Jul. 22
Aug. 8.	Dam, pipe line, etc., Oneida, N. Y. Adv. Jul. 22.	Jul. 22
Aug. 8.	System, Republic, Mich. Adv. Aug. 5.	Jul. 29
Aug. 8.	Pipe, valves, etc., Troy, N. Y.	Jul. 29
Aug. 8.	Water-works, Oxford, Pa.	Aug. 5
Aug. 8.	Water-works, Parkston, S. D. Adv. Aug. 5.	Aug. 5
Aug. 9.	Improv., Ft. Revere, Hull, Mass.	Jul. 22
Aug. 9.	Pumping Station, Brooklyn, N. Y.	Jul. 29
Aug. 9.	Expert services, Chicago, Ill.	Jul. 29
Aug. 9.	Reservoir, etc., Franklin, N. H. Adv. Aug. 5.	Aug. 5
Aug. 9.	Water works, Plymouth, O.	Aug. 5
Aug. 10.	Water wks., Cottage Grove, Ore.	Jul. 29
Aug. 10.	Water wks., Bolivar, Tenn.	Jul. 29
Aug. 11.	Stand pipe and tank, Grand Rapids, Mich. Adv. Jul. 22 to 29.	Jul. 22
Aug. 12.	Water wks., Newark, O. Adv. Jul. 15 to 29.	Jul. 15
Aug. 12.	Tower, etc., St. Martin, Minn.	Aug. 5
Aug. 14.	Pipe, etc., Lyndhurst, N. J. Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 14.	Mains, Grand Rapids, Mich.	Jul. 29
Aug. 14.	System, Lone Tree, Ia.	Jul. 29
Aug. 14.	Reservoir, etc., Lake Placid, N. Y. Adv. Aug. 5.	Aug. 5
Aug. 14.	Well, etc., Indianapolis, Ind.	Aug. 5
Aug. 14.	Well, Victoria, Tex.	Aug. 5
Aug. 14.	Mains, Union City, Pa. Adv. Aug. 5.	Aug. 5
Aug. 14.	Franchise, Somerset, Ky.	Aug. 5
Aug. 15.	Reservoir, etc., Ft. McPherson, Ga. Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 15.	Reservoir embankm't, Mt. Vernon, Ill. Adv. Aug. 5.	Aug. 5
Aug. 15.	Meters, etc., Washington, D. C.	Aug. 5
Aug. 15.	Cisterns, Ft. Caswell, N. C.	Aug. 5
Aug. 15.	Water works improv., Uxbridge, Mass. Adv. Aug. 5.	Aug. 5
Aug. 15.	Pumping engine, Edmonton Alta, Can.	Aug. 5
Aug. 16.	Dam, etc., Casper, Wyo. Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 16.	Pumping plant, engine, etc., Brooklyn, N. Y.	Aug. 5
Aug. 16.	Monitors, New York, N. Y.	Aug. 5
Aug. 17.	**Irrigation, Yuma, Ariz. Adv. Jun. 17 to Jul. 22.**	**Jun. 17**
Aug. 18.	Mains, White Hall, Ill.	Aug. 5
Aug. 24.	System, Marksville, La. Adv. Aug. 5.	Jul. 29
Aug. 25.	Pipe, etc., Panama Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 26.	Reservoir, Ft. Moultrie, S. C.	Jul. 29
Aug. 26.	Boiler, Ft. Ringgold, Tex.	Jul. 29
Aug. 28.	Canal, etc., Montrose, Colo. Adv. Jul. 15 to Aug. 5.	
Aug. 28.	Pumping plant, Winnipeg, Man. Adv. Aug. 5.	Aug. 5
Aug. 30.	Improv., Owensboro, Ky.	Jul. 15
Aug. —.	Improv., Donalsonville, La.	Jul. 15
Sep. 2.	Pumping unit, Niagara Falls, Ont. Adv. Aug. 5.	Aug. 5
Sept. 5.	Dam, etc., Cody, Wyo. Adv. Jul. 15 to Aug. 5.	Jul. 15
Sept. 6.	Tunnel, etc., Cody, Wyo. Adv. Jul. 15 to Aug. 5.	Jul. 15
Sep. 14.	Pumping machinery, Columbus, O. Adv. Aug. 5.	Aug. 5
Sep. 19.	Pumps, etc., Toronto, Ont. Adv. Aug. 5.	Aug. 5
Oct. 12.	Sale of standpipe, Attleboro, Mass. Adv. Jul. 29 to Aug. 5.	Jul. 29
———	Water wks., Utica, Miss.	Jul. 15
———	Water wks. or franchise, Muncie, Ind. Adv. Jul. 29.	Jul. 29

SEWERAGE AND SEWAGE DISPOSAL.

Aug. 8.	West Point, N. Y. Adv. Jul. 15 to Aug. 5.	Jul. 15
Aug. 8.	Tell City, Ind.	Jul. 29
Aug. 8.	Corning, Iowa	Aug. 5
Aug. 8.	Brownstown, Ind.	Aug. 5
Aug. 9.	Indianapolis, Ind.	Jul. 29
Aug. 9.	Brooklyn, N. Y.	Aug. 5
Aug. 9.	Marion, O.	Aug. 5
Aug. 10.	Middletown, O. Adv. Aug. 5.	Aug. 5
Aug. 10.	Philadelphia, Pa.	Aug. 5
Aug. 10.	Winnetka, Ill.	Aug. 5
Aug. 11.	Cincinnati, O.	Jul. 15
Aug. 11.	Grand Rapids, Mich. Adv. Jul. 22 to 29.	Jul. 22
Aug. 11.	Bloomington, Ill.	Aug. 5
Aug. 11.	Centreville, Ia.	Aug. 5
Aug. 12.	Norwood, O.	Jul. 22
Aug. 14.	Cincinnati, O.	Jul. 22
Aug. 14.	Beloit, Wis.	Aug. 5
Aug. 15.	New Britain, Conn. Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 16.	Winchester, Ind.	Jul. 29
Aug. 19.	Norwood, O.	Jul. 29
Aug. 21.	Steubenville, O. Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 23.	Chicago, Ill. Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 24.	Clinton, Ia.	Jul. 29
Sep. 1.	Kenton, O.	Aug. 5

BRIDGES.

Aug. 7.	Boston, Mass.	Aug. 5
Aug. 8.	Merced, Cal.	Jul. 22
Aug. 8.	Fargo, N. D.	Jul. 22
Aug. 8.	Brownstown, Ind.	Jul. 29
Aug. 8.	Stockton, Cal.	Jul. 29
Aug. 9.	Salem, N. J. Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 9.	Jacksonville, Fla.	Jul. 29
Aug. 9.	Lockhaven, Pa.	Aug. 5
Aug. 10.	Bridgeport, Conn. Adv. Jul. 22 to 29.	Jul. 22
Aug. 10.	New York, N. Y. Adv. Aug. 5.	Aug. 5
Aug. 11.	Stockton, Mo.	Jul. 29
Aug. 11.	New Haven, Conn. Adv. Aug. 5.	Aug. 5
Aug. 12.	Ironton, O.	Aug. 5
Aug. 15.	St. Clairsville, O.	Jul. 29
Aug. 15.	Napa, Cal.	Aug. 5
Aug. 16.	Cleveland, O.	Jul. 29
Aug. 16.	Ithaca, N. Y.	Aug. 5
Aug. 19.	Norristown, Pa.	Jul. 29
Aug. 21.	Bowling Green, O.	Aug. 5
Aug. 21.	Concord, Me.	Aug. 5
Aug. 21.	Chillicothe, O.	Aug. 5
Aug. 21.	Huntington, W. Va.	Aug. 5
Sept. 8.	Virginia City, Mont.	Jul. 22
Sep. 30.	San Juan, P. R.	Aug. 5

PAVING AND ROADMAKING.

Aug. 7.	Ingram, Pa.	Aug. 5
Aug. 7.	Jersey City, N. J.	Aug. 5
Aug. 7.	Thomaston, Conn.	Aug. 5
Aug. 8.	Shreveport, La.	Jul. 1
Aug. 8.	Corydon, Ind.	Jul. 22
Aug. 8.	Knox, Ind.	Jul. 22
Aug. 8.	Vincennes, Ind.	Jul. 22
Aug. 8.	Logansport, Ind.	Jul. 22
Aug. 8.	Auburn, N. Y.	Jul. 22
Aug. 8.	New Brighton, S. I.	Jul. 29
Aug. 8.	Washington, D. C.	Jul. 29
Aug. 8.	Knoxville, Tenn.	Jul. 29
Aug. 8.	Bellevue, Pa.	Aug. 5
Aug. 8.	Rockville, Md.	Aug. 5
Aug. 8.	Centreville, Md.	Aug. 5
Aug. 8.	Hagerstown, Md.	Aug. 5
Aug. 8.	Manchester, Ia.	Aug. 5
Aug. 9.	Indianapolis, Ind.	Jul. 29
Aug. 9.	Chicago, Ill.	Aug. 5
Aug. 9.	Meadville, Pa. Adv. Aug. 5.	Aug. 5
Aug. 9.	Marion, O.	Aug. 5
Aug. 10.	New York, N. Y.	Aug. 5
Aug. 10.	Sullivan, Ind.	Aug. 5
Aug. 11.	Cincinnati, O.	Jul. 15
Aug. 11.	Napoleon, O.	Jul. 29
Aug. 11.	Rock Island, Ill.	Aug. 5
Aug. 11.	Bloomington, Ill.	Aug. 5
Aug. 12.	Scottsburg, Ind.	Jul. 29
Aug. 12.	Norristown, Pa.	Jul. 29
Aug. 12.	Media, Pa.	Aug. 5
Aug. 12.	Seymour, Conn.	Aug. 5
Aug. 12.	Greencastle, Ind.	Aug. 5
Aug. 12.	Seattle, Wash.	Aug. 5
Aug. 14.	Cincinnati, O.	Jul. 22
Aug. 15.	Crownpoint, Ind.	Jul. 22
Aug. 15.	Mobile, Ala.	Jul. 29
Aug. 15.	Washington, D. C.	Aug. 5
Aug. 15.	Suffolk, Va.	Aug. 5
Aug. 16.	Newburgh, N. Y.	Aug. 5
Aug. 16.	Brooklyn, N. Y.	Aug. 5
Aug. 17.	Cincinnati, O.	Jul. 29
Aug. 17.	Towson, Md. (2 proposals) Adv. Aug. 5.	Aug. 5
Aug. 17.	Greensboro, N. C. Adv. Aug. 5.	Aug. 5
Aug. 19.	Norwood, O.	Jul. 29
Aug. 21.	Johnstown, N. Y.	Jul. 22
Aug. 22.	Alliance, O.	Aug. 5
Aug. 23.	Madisonville, O.	Aug. 5
Aug. 28.	Asphalt plant, New Orleans, La. Adv. Jul. 29 to Aug. 5.	Jul. 29
Sep. 5.	Norwalk, O.	Aug. 5

POWER, GAS AND ELECTRICITY.

Aug. 8.	Electric supplies, Pensacola, Fla.	Jul. 29
Aug. 8.	Washington, D. C.	Jul. 29
Aug. 9.	Plymouth, O.	Aug. 5
Aug. 10.	Bellefontaine, O.	Jul. 15
Aug. 10.	El. light fixtures, Washington, D. C.,	Jul. 22
Aug. 10.	Bolivar, Tenn.	Jul. 29
Aug. 12.	Stoughton, Wis.	Aug. 5
Aug. 14.	Lake Placid, N. Y. Adv. Aug. 5.	Aug. 5
Aug. 14.	Brooklyn, N. Y.	Aug. 5
Aug. 14.	Somerset, Ky.	Aug. 5
Aug. 15.	**Campbellsville, Ky.**	**Jun. 24**
Aug. 15.	Electric light fixtures, Pekin, Ill.	Jul. 29
Aug. 15.	Russell, Ky.	Jul. 29
Aug. 15.	Pulaski, Va.	Jul. 29
Aug. 19.	Ft. Myer, Va. Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 21.	Moose Jaw, N. W. Ter.	Aug. 5
Aug. 24.	Fort Wayne, Ind.	Jul. 8
Aug. 24.	Marksville, La. Adv. Aug. 5.	Jul. 29
Aug. 28.	Washington, D. C. Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 28.	Winnipeg, Man. Adv. Aug. 5.	Aug. 5
Aug. —.	Waukegan, Ill.	Jul. 29
Sep. 6.	Ukiah, Cal.	Aug. 5
Sep. 30.	Washington, D. C. Adv. Aug. 5.	Aug. 5
Oct. 1.	**Tacoma, Wash.**	**Jul. 8**

BUILDINGS.

Aug. 8.	Htg. jail, Aberdeen, Miss.	Jul. 22
Aug. 8.	School, Minot, N. D.	Jul. 22
Aug. 8.	School, Englewood, N. J. Adv. Jul. 29.	Jul. 29
Aug. 8.	Stable, New Brighton, S. I.	Jul. 29
Aug. 8.	School, Maynard, Mass.	Jul. 29
Aug. 8.	Church, Terrell, Tex.	Aug. 5
Aug. 8.	Htg. school, Indianapolis, Ind.	Aug. 5
Aug. 9.	Pub. bldgs., Chicago, Ill.	Jun. 17
Aug. 9.	**School library, Bloomington, Ind. Adv. Jul. 8.**	**Jul. 8**
Aug. 9.	Library, Louisville, Ky.	Jul. 22
Aug. 10.	Jail, Salem, Va.	Jul. 15
Aug. 10.	Church, Lexington, Tenn.	Jul. 29
Aug. 10.	Bank, Guin, Ala.	Jul. 29
Aug. 10.	School, Hackensack, N. J.	Jul. 29
Aug. 10.	Htg., etc., pub. bldg., New York, N. Y.	Aug. 5
Aug. 11.	Htg. library, Cincinnati, O.	Jul. 22
Aug. 11.	Masonic temple, New Augusta, Ind.	Jul. 29
Aug. 11.	Engine house, Chicago, Ill.	Jul. 29
Aug. 11.	Market, New York, N. Y.	Aug. 5
Aug. 12.	School, Rocky River, O.	Jul. 22
Aug. 12.	School, Oakville, Mo.	Jul. 29
Aug. 12.	School, Columbus, O.	Jul. 29
Aug. 14.	**Court House, Cedartown, Ga.**	**Jul. 8**
Aug. 14.	U. S. Custom House, Baltimore, Md. Adv. Jul. 15, 22.	Jul. 15
Aug. 14.	School, Cleveland, O.	Jul. 22
Aug. 14.	Pub. bldg. improv., Cincinnati, O.	Jul. 22
Aug. 14.	Schools, New York, N. Y.	Aug. 5
Aug. 14.	Bus. bldg., North Platte, Neb.	Aug. 5
Aug. 15.	Pub. bldgs, htg., etc., New York, N. Y. Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 15.	School plans, Laurel, Miss.	Jul. 29
Aug. 15.	Jail improv., Crookston, Minn.	Jul. 29
Aug. 15.	School, Grindstone City, Mich.	Aug. 5
Aug. 15.	Court house, Choteau, Mont.	Aug. 5
Aug. 15.	Remov. pub. bldg., St. Louis, Mo.	Aug. 5
Aug. 15.	Hospitals, Kansas City, Mo.	Aug. 5
Aug. 16.	P. O., McKeesport, Pa.	Jul. 15
Aug. 16.	Post bldgs., Ft. Mott, N. J. Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 16.	School, Youngstown, O.	Jul. 29
Aug. 16.	School library, Bloomington, Ind.	Aug. 5
Aug. 17.	Lighthouse, Buffalo, N. Y.	Jul. 15
Aug. 17.	P. O. extension, Burlington, Ia.	Jul. 15
Aug. 17.	School bldgs., Hayward, Wis.	Jul. 29
Aug. 17.	Pub. bldg., Cooperston, Ill.	Aug. 5
Aug. 19.	Pub. bldg., Portsmouth, N. H.	Jul. 29
Aug. 21.	Hospital, Southport, N. C.	Jul. 22
Aug. 21.	Plumbing, htg., etc., college, Ithaca, N. Y. Adv. Aug. 5	Aug. 5
Aug. 21.	Court house, Caldwell, Idaho	Aug. 5
Aug. 22.	School, Santa Fe, N. M.	Jul. 29
Aug. 24.	Htg. P. O. bldg., Lincoln, Neb. Adv. Aug. 5.	Aug. 5
Aug. 24.	Post bldgs., Ft. Wm. H. Seward, Alaska	Aug. 5
Aug. 25.	School, La Moure, N. D.	Jul. 29
Aug. 26.	Htg. hotel, Cincinnati, O.	Jul. 22
Aug. 26.	Court house, Franklinton, La.	Aug. 5
Aug. 28.	Hospital bldgs., Buffalo, N. Y.	Jul. 29
Aug. 28.	Post bldgs., Ft. DuPont, Del. Adv. Aug. 5.	Aug. 5
Aug. 29.	School addition, Lakewood, O.	Aug. 5
Sep. 1.	City hall, plans, Regina, N. W. Ter.	Aug. 5
Sep. 4.	Htg., etc., courthouse, Huntington, Ind.	Jul. 29
Sep. 14.	Bus. bldg., St. Louis, Mo.	Aug. 5
Sep. 30.	Htg., etc., pub. bldg., Washington, D. C. Adv. Aug. 5	Aug. 5

MISCELLANEOUS.

Aug. 8.	Dredge work, Wauseon, O.	Jul. 15
Aug. 8.	Ditch, Cleveland, O.	Jul. 22
Aug. 8.	Levee work, Walnut Hill, Ark.	Jul. 22
Aug. 8.	Cement, etc., Key West, Fla.	Jul. 29
Aug. 8.	Supplies, Washington, D. C.	Jul. 29
Aug. 8.	Cement, lime, etc., Panama Adv. Jul. 29 to Aug. 5.	Jul. 29
Aug. 9.	**Dock, Chicago, Ill.**	**Jun. 17**
Aug. 9.	Ditch, South Bend, Ind.	Aug. 5
Aug. 10.	Levee work, New Orleans, La. Adv. Jul. 15 to Aug. 5.	Jul. 15
Aug. 10.	Dredging, Los Angeles, Cal. Adv. Jul. 22.	Jul. 22
Aug. 10.	Dredging, Pittsburg, Pa.	Jul. 29
Aug. 10.	Wall, Brooklyn, N. Y.	Aug. 5
Aug. 11.	Levee work, New Orleans, La. Adv. Jul. 15 to Aug. 5.	Jul. 15
Aug. 11.	Supplies, Panama	Jul. 15
Aug. 11.	Dredging, Norfolk, Va. Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 14.	Conduit, Middletown, N. Y.	Aug. 5
Aug. 11.	Ditch, Valparaiso, Ind.	Jul. 29
Aug. 12.	Steel work, etc., Washington, D. C.,	Jul. 22
Aug. 14.	Dredging, Detroit, Mich. Adv. Jul. 15 to 29.	Jul. 15
Aug. 15.	Supplies, Washington, D. C.	Jul. 29
Aug. 15.	Cement, etc., Washington, D. C.	Jul. 29
Aug. 15.	Subways, Memphis, Tenn.	Jul. 29
Aug. 15.	Cement, etc., Washington, D. C.	Aug. 5
Aug. 15.	Steps, etc., Newark, N. J. Adv. Aug. 5.	Aug. 5
Aug. 17.	Dredging, Norfolk, Va.	Jul. 15
Aug. 17.	Printing presses, etc., Panama Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 17.	Broken stone, etc., New York, N. Y.	Aug. 5
Aug. 18.	Dredging, Newport, R. I. Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 18.	Inlet wall, San Francisco, Cal. Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 19.	Dredges, Panama Adv. Jul. 22 to Aug. 5.	Jul. 22
Aug. 19.	Boring in Lake Michigan, Chicago, Ill.	Jul. 29
Aug. 19.	Dredging, Seattle, Wash.	Aug. 5
Aug. 21.	Steel bars, Glendive, Mont. Adv. Jul. 22 to Aug. 5.	Jul. 15
Aug. 21.	Garb. disposal, Indianapolis, Ind.	Jul. 22
Aug. 21.	Crane for sewer, Washington, D. C. Adv. Jul. 22 to 29.	Jul. 22
Aug. 21.	Dredging, Wilmington, Del.	Jul. 29
Aug. 22.	Drills, etc., Panama Adv. Jul. 22 to 29.	Jul. 22
Aug. 26.	**Coal plant, Olongapo, P. I.**	**May 6**
Aug. 26.	Filling etc., Key West, Fla.	Jul. 22
Aug. 26.	Dredging, New London, Conn. Adv. Aug. 5.	Aug. 5
Aug. 28.	Sanitary fixtures, Panama	Aug. 5
Aug. 29.	Machines, etc., San Francisco, Cal.	Jul. 29
Aug. 30.	Breakwater, Newport, R. I. Adv. Aug. 5.	Aug. 5
Aug. 31.	Lock and dam, Nashville, Tenn. Adv. Aug. 5.	Aug. 5
Aug. 31.	Dredging, Portland, Me. Adv. Aug. 5.	Aug. 5
Sep. 1.	**Steel and iron, Sydney, N. S. Wales. Adv. Apr. 8, 22; May 6, 20; Jun. 3, 17.** Adv. Jul. 1, 15.	**Apr. 8**
Sep. 1.	Crane, Augusta, Ga.	Jul. 29
Sep. 5.	Dredging, Oakland, Cal. Adv. Aug. 5.	Aug. 5
Sep. 9.	R. R. work, Miami, Fla. Adv. Jul. 15 to Aug. 5.	Jul. 29
Nov. 1.	**R. R. work, Manila, P. I.** Adv. Jul. 29.	**Jun. 17**
Nov. 9.	Wharf, etc., Havana, Cuba	Jul. 29
Jan. 1.	Statue plans, Indianapolis, Ind.	Jul. 22
Apr. 2,	'06. Harbor Work, Valparaiso, **Chili,** Adv. Jul. 29 to Aug. 5.	**Apr. 29**
———	Dam, etc., Charlestown, W. Va. Adv. Jul. 8, 15.	Jul. 1
———	R. R. work, Shreveport, La.	Jul. 29
———	Garb. disposal, Washington, Pa. Adv. Jul. 29, Aug. 5.	Jul. 29